



CFTRI-MYSORE



3100

Handbook of solv.



- 3100 ① solvent action
- ② solvent power
- ③ vapor pressure
- ④ dilution ratio
- ⑤ inflammability
- ⑥ solvent recovery
- ⑦ adsorption
- ⑧ solvent strength
- ⑨

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THE HANDBOOK OF

SOLVENTS

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# THE HANDBOOK OF SOLVENTS

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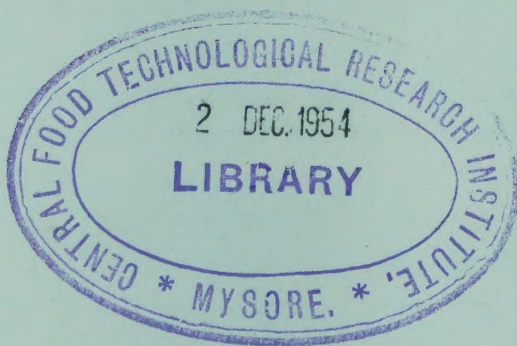
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## PREFACE

*The Handbook of Solvents* consists of two major sections. In the first section, various theoretical aspects and practical attributes of solvents such as solvent action, solvent power, evaporation and evaporation rates, and limits of inflammability are considered. The subject of solvent recovery is discussed in detail and is annotated with many literature references. The important subject of safe practices in the use of solvents is stressed both from the point of view of industrial hygiene and of fire hazard.

In the second section, the physical constants of more than 2700 liquid organic compounds are tabulated. This comprehensive survey of commercial solvents and substances that may possibly be used as solvents and thus attain commercial use was compiled and tabulated by the authors over a period of years. The arrangement of the data enables one to compare the so-called literature constants and commercial constants of each solvent at a glance.

The system of nomenclature adopted is that of *Chemical Abstracts*, but the C.A. system has not been slavishly followed. For instance, the inverted ester form has been abandoned in favor of the use of the common ester name. Thus, data for amyl acetate are given under *amyl acetate* and not under *acetic acid amyl ester*. An exhaustive index of synonyms with cross references has been included so that ease of reference regardless of name will be promoted.

Because the vapor pressure of pure organic compounds has been tabulated by D. R. Stull, *Ind. Eng. Chem.* **39**, 517-550 (1947), there is no need to repeat this tabulation but the vapor pressure of commercial solvents has been included where such data were available.

We wish to thank the many firms that cooperated with us by supplying us with technical bulletins, booklets, and data sheets describing their particular products.

It is our hope that we have made a useful contribution to the literature of solvents.

*Tel Aviv, Israel, 1953*  
*Brooklyn, New York, 1953*

LEOPOLD SCHEFLAN  
MORRIS B. JACOBS



# CONTENTS

CHAPTER	PAGE
I. INTRODUCTION . . . . .	1
Definition . . . . .	1
Amount of Solvents Manufactured . . . . .	3
Classification . . . . .	4
Boiling Points . . . . .	4
Rates of Evaporation . . . . .	4
Polarity . . . . .	4
Industrial Applications and Uses . . . . .	5
Chemical Composition . . . . .	5
Behavior Toward Magdala Red . . . . .	6
II. SAFE PRACTICES IN THE USE OF <u>SOLVENTS</u> . . . . .	7
Identification of Hazardous Operations . . . . .	7
Analysis of the Hazards . . . . .	9
Physiological Response . . . . .	9
Chronic Exposure . . . . .	9
Classification of Physiological Action . . . . .	9
Dermatitis . . . . .	10
Prevention of Exposure . . . . .	10
Maximum Allowable Concentrations . . . . .	11
Engineering Controls . . . . .	11
Chemical Controls . . . . .	15
Fire Precautions . . . . .	15
Classification of Fires . . . . .	16
Personal Protection . . . . .	16
Protection Against Inhalation . . . . .	17
Respirator Types . . . . .	17
Precautions in the Use of Respirators . . . . .	18
Approved Respirators . . . . .	18
Protection Against Dermatitis . . . . .	19
Protective Wearing Apparel . . . . .	19
Protective Ointments and Barrier Creams . . . . .	19
Spillage . . . . .	20
Medical Protection . . . . .	20
Supervision . . . . .	21
Employee Education . . . . .	22

CHAPTER	PAGE
III. <u>SOLVENT ACTION AND POWER</u>	24
Solvent Action, Definition	24
True Solutions	25
Cellulose Ester Solubility	25
Dye Solubility	27
Mechanism for Resinous Substances	27
Solute-Solvent Relationships	28
Solvent Power	28
Associated Liquids	29
Dielectric Constant	29
Compressibility	30
Evaporation	30
X Viscosity	31
Viscosity Reduction	31
Kauri-Butanol Test	31
Aniline Point Test	33
Resin Solvency	34
Mix-Solvency	34
Velocity of Solution	34
IV. <u>VAPOR PRESSURE</u>	36
Clausius-Clapeyron Equation	36
Trouton's Rule	36
Raoult's Law	37
Henry's Law	37
Regnault's Law	38
Evaporation and Evaporation Rates	39
Calculation of Relative Rate	42
Evaporation Rates and Temperature	42
Relative Evaporation Rates	43
Constant-Evaporating Liquid Mixtures	44
Velocity of Evaporation	45
Measurement of Evaporation Rates	45
V. <u>DILUTION RATIOS</u>	47
Definition	47
Dilution Ratio as Measure of Solvent Power	47
Solvent Strength	47
Esters	50
Ketones	50
Ether-Alcohols	51

CHAPTER	PAGE
VI. LIMITS OF INFLAMMABILITY . . . . .	52
Definitions of Explosive Limits . . . . .	52
Upper . . . . .	52
Lower . . . . .	52
Calorific Value and Limits of Inflammability . . . . .	52
Calculation of Limits of Inflammability . . . . .	53
Elimination of Fire Hazard . . . . .	53
VII. SOLVENT RECOVERY . . . . .	55
Solvent Recovery in General . . . . .	55
Condensation . . . . .	56
Absorption . . . . .	58
Inorganic Absorbing Solutions . . . . .	59
Water . . . . .	59
Acidified Water . . . . .	59
Brine Solutions . . . . .	59
Lithium Chloride . . . . .	59
Sodium Bisulfite . . . . .	59
Sulfuric Acid . . . . .	59
Phosphoric Acid . . . . .	59
Organic Absorbing Solutions . . . . .	60
Alcohols . . . . .	60
Oils . . . . .	60
Cresol and the Bregéat Process . . . . .	60
Toluene and Coal-Tar Derivatives . . . . .	60
Acetone Oil and Aniline . . . . .	60
Carboxylic Acids . . . . .	60
Phosphoric Acid Esters . . . . .	62
VIII. SOLVENT RECOVERY BY ADSORPTION . . . . .	63
Adsorption . . . . .	63
Adsorption Equilibrium . . . . .	63
Freundlich Isotherm . . . . .	63
Langmuir Equation . . . . .	64
Patrick Formula . . . . .	64
Adsorption and Temperature . . . . .	64
Heat Evolution . . . . .	64
Adsorption of Mixtures . . . . .	65
Selective Action . . . . .	65
Rate of Adsorption . . . . .	65
Recovery Methods . . . . .	66
Activated Carbon . . . . .	66
Adsorption Equilibria . . . . .	68

CHAPTER	PAGE
Columbia Activated Carbon Systems . . . . .	70
Carbo-Union System . . . . .	70
Other Processes . . . . .	72
Separation of Adsorbed Solvents . . . . .	72
Silica Gel . . . . .	73
Yamagata Clay . . . . .	74
Rubber . . . . .	74
Desorption . . . . .	74
Distillation . . . . .	76
Solvent Recovery by Use of a Solvent of Lower Boiling Point	78
IX. TABLE OF SOLVENTS . . . . .	79
LIST OF SOURCES . . . . .	688
INDEX OF SYNONYMS . . . . .	695

# Chapter I

## INTRODUCTION

The first solvent used by man was undoubtedly water; however, its first use by man for industrial purposes is shrouded in the unrecorded events of prehistoric times.

In the first half of the 20th century many solvents were employed regularly in industry, research laboratories, and colleges. However, the number of solvents used commercially at present is small compared to the much larger number of liquids which are not being used to any extent at this time either because they are too expensive, because they are not readily available or completely unavailable, or because no practical applications have been discovered for them. The tables forming the second part of this book contain data concerning not only the common solvents but also data concerning a large selection of currently "rare" or unused solvents. These are included in the hope that a tabulation and consideration of their properties will suggest applications not heretofore considered by industrial and research workers.

There are several types of solvents which will not be included in this discussion of solvents: gaseous solvents, solid solvents, and liquid metals. These types of solvents differ so greatly from the other types of solvents mentioned above that it was considered unwise to include them in this text. However, since there are three states of matter—solid, liquid, and gas—which can act as solvents, it should be remembered that these three types of potential solvents can form nine types of solutions, namely: solutions of a gas, a liquid, or a solid in a gas; solutions of a gas,

a liquid, or a solid in a liquid; and solutions of a gas, a liquid, or a solid in a solid. Solutions of all nine types are known, but not all of them are of equal importance.

**Definition.**—The literature contains various definitions of the term *solvent*. Thus, Webster<sup>1</sup> defines solvent as "a substance, usually a liquid, capable of, or used in, dissolving something, as water is the appropriate solvent of most salts, alcohol of resins, ether of fats." Bennett<sup>2</sup> defines it as the "component of a solution which is present in excess; liquid used to dissolve a substance." Hackh<sup>3</sup> goes further than that and lists these three interpretations: "(1) That component of a homogeneous mixture which is in excess; (2) a liquid which dissolves another substance (solute), generally a solid, without any changes in chemical composition; as sugar or salt dissolving in water; (3) a liquid which reacts chemically with a solid and brings it into solution, as acids which dissolve metals."

In industry it is generally understood that solvents are simple or complex, pure or impure, compounds or mixtures of compounds (either natural or synthetic) which dissolve many water-insoluble products like fats, waxes, resins, etc., forming homogeneous solutions; that such organic solvents dissolve these water-insoluble products in various

<sup>1</sup> Webster's *New International Dictionary*, 7th ed. Merriam, Springfield, 1937.

<sup>2</sup> H. Bennett, *Concise Chemical and Technical Dictionary*. Chemical Publishing, Brooklyn, 1947.

<sup>3</sup> J. Grant, *Hackh's Chemical Dictionary*. Blakiston, Philadelphia, 1944.

TABLE 1. SOLVENTS USED IN PRINCIPAL SOLVENT-CONSUMING INDUSTRIES <sup>a</sup>

Paint Varnish Lacquer Ink	Anti-freeze	Rayon	Pharmaceuticals	Textile (Other than Rayon)	Automobile (Exclusive of Anti-freeze and Paint)	Petroleum Refining		Dry Cleaning
						Selective Solvent Extraction	Solvent Dewaxing	
Turpentine	Ethanol	Acetone	Alcohols	Glycols	Chlorinated hydrocarbons	Dichloroethyl ether	Propane	Naphtha
Alcohols	Methanol	Ethers	Ethers	Glycol derivatives	Ether-alcohols	Phenol	Benzene	Chlorinated hydrocarbons
Esters	Isopropanol	Esters	Ketones	Glycerol	Polyether- alcohols	Furfural	Acetone	
Ketones	Glycol		Chlorinated hydrocarbons	Lacquer solvents	Plasticizers	Benzene-SO <sub>2</sub>	Methyl ethyl ketone	
Ether-alcohols	Glycerol			Hydrocarbons		Propane- cresylic acid	Ethylene dichloride	
Coal tar hydro- carbons				Pine oil and derivatives		Nitrobenzene		
Plasticizers								

<sup>a</sup> From A. K. Doolittle, *Paint, Oil, and Chem. Rev.* 102, No. 10, 42 (1940).

proportions depending on the solvent power of the solvent, the degree of solubility of the solute, and the temperature; and that the solute can be recovered with its original properties by the removal of the solvent from the solution. It is also understood in industry that there is a much more limited number of solvents which do not have the properties given above but which nevertheless are of considerable importance; they are the inorganic solvents like water, liquid ammonia, liquid metals, inorganic gases, and the like.

**Amount of Solvents Manufactured.**—Doolittle<sup>4</sup> estimated that the amount of solvents annually manufactured and sold in 1935 (with the exclusion of petroleum distillates) was approximately 200,000,000 gallons and that in 1935 the proportionate production of these solvents was approximately as follows:

<i>Solvent</i>	<i>% by Volume</i>
Industrial alcohol and turpentine . . .	50
Pyroxylin lacquer solvents and coal tar distillates . . . . .	15
Carbon disulfide and acetone . . . . .	15
Glycerol, glycol, and methyl alcohol . . . . .	15
All others . . . . .	5
	<u>100</u>

In that year the proportions of the total volume of solvents produced and used by the most important solvent-consuming industries were as follows:

<i>Solvent-consuming Industries</i>	<i>% by Volume</i>
Paint, varnish, and lacquers and inks . . . . .	40
Anti-freeze . . . . .	20
Rayon . . . . .	20
Pharmaceuticals . . . . .	10
Textile (exclusive of rayon) . . . . .	5
Miscellaneous . . . . .	5
	<u>100</u>

The production of benzene (excluding that for motor fuel) in 1950 amounted to 186

million gallons, an increase of 39.7% over the 133 million gallons produced in 1949. The production of motor benzene in 1950, which totaled 14 million gallons, was 39.2% less than the volume of 23 million gallons in 1949. The production of toluene in 1950 totaled 84 million gallons of which total 54% came from petroleum sources. The quantity of xylene produced in 1950 was 72 million gallons and was 24.9% greater than the 58 million gallons produced in 1949. Of this total, 62 million gallons, equivalent to 87%, came from petroleum sources.

The production of synthetic organic chemicals in 1950 as detailed by the U. S. Tariff Commission (Report No. 173 Second Series, 1951) was:

	<i>Production 1000 lbs.</i>
Acetic acid . . . . .	441,166
Acetic anhydride . . . . .	907,743
Acetone . . . . .	482,491
Amines . . . . .	85,672
Butyl alcohols . . . . .	323,532
Amyl alcohol, 100% . . . . .	16,847
Butyl acetates . . . . .	76,518
Carbon disulfide . . . . .	426,088
Dichlorodiethyl ether . . . . .	6,356
Diethyl malonate . . . . .	764
Dipropylene glycol . . . . .	4,304
Ethyl acetate, 85% . . . . .	91,872
Ethyl alcohol, synthetic . . . . .	735,440
Ethylene glycol . . . . .	519,013
Ethyl ether . . . . .	37,874
Ethyl formate . . . . .	313
Ethyl mercaptan . . . . .	43
Fatty acid esters . . . . .	1,223
Formaldehyde, 37% . . . . .	835,142
Formic acid, 90% . . . . .	15,703
Halogenated hydrocarbons . . . . .	2,089,606
Carbon tetrachloride . . . . .	216,558
Chloroform . . . . .	20,285
Ethylene dichloride . . . . .	304,581
Methylene chloride . . . . .	39,672
Vinyl chloride and vinylidene chloride monomers . . . . .	249,532
Isopropyl acetate . . . . .	27,388

<sup>4</sup> A. K. Doolittle, *Paint, Oil and Chem. Rev.* **102**, No. 10, 42 (1940).

	<i>Production 1000 lbs.</i>
Isopropyl alcohol . . . . .	865,980
Lactic acid, 100% . . . . .	5,455
Methyl alcohol, synthetic . . . . .	901,584
Polyglycerol . . . . .	55
Propionic acid and anhydride . . . . .	13,525
Propylene glycol . . . . .	78,964

**Classification.**—Solvents have been classified on various arbitrary bases, e.g.:

1. Boiling point.
2. Evaporation rate.
3. Polarity.
4. Industrial applications.
5. Chemical composition.
6. Proton donor and proton acceptor relationships.
7. Behavior toward Magdala Red.

Typical classifications are given below:

#### *Boiling Points*<sup>5</sup>

1. Low-boiling solvents (boiling points below 100° C.):  
e.g., methyl acetate.
2. Medium-boiling solvents (boiling points near 125° C.):  
e.g., amyl alcohol.
3. High-boiling solvents (boiling points between 150 to 200° C.):  
e.g., xylene.
4. Plasticizers and softeners (boiling points near 300° C. or above):  
e.g., tri-*o*-cresyl phosphate.

#### *Rates of Evaporation*<sup>6</sup>

1. Fast-evaporating solvents (liquids having evaporation rates at least three

times greater than that of butyl acetate):

e.g., acetone, ethyl acetate, benzene.

2. Medium-evaporating solvents (liquids having evaporation rates greater than 1½ times that of butyl acetate):

e.g., ethyl alcohol, toluene, *sec.*-butyl acetate.

3. Slow-evaporating solvents (liquids having evaporating rates greater than that of Pentasol but slower than that of secondary butyl acetate):

e.g., butyl acetate, amyl alcohol, Cellosolve.

4. Extra-slow-evaporating solvents (liquids evaporating more slowly than Pentasol):

e.g., ethyl lactate, diacetone alcohol, butyl Cellosolve.

#### *Polarity*<sup>7</sup>

1. Polar solvents (solvents containing the hydroxy or ketonic groups, associated with strong polarity and high dielectric constants):

e.g., alcohols, acetone.

Polar solvents dissolve shellac substitutes including phenolic resins of both heat hardening and non-heat hardening types, glyptals and acrolein resins and are of interest to the electrical insulation industry.

2. Non-polar solvents (solvents with low dielectric constants):

e.g., hydrocarbons, benzene, petroleum hydrocarbons, carbon disulfide.

Non-polar solvents dissolve amberols, oil-soluble phenolic resins, polymerized coumarone resins, etc., and are used primarily in the manufacture of varnishes.

<sup>7</sup> J. Drummond, *Trans. Inst. Rubber Ind.* **4**, 40 (1928).

<sup>5</sup> D. B. Keyes, *Ind. Eng. Chem.* **17**, 558 (1925).

<sup>6</sup> C. D. Bogin in J. J. Mattiello, *Protective and Decorative Coatings*, Chapter 27; Wiley, New York, 1947.

Industrial Applications

	EXAMPLE
1. Solvents for acetylcellulose .....	acetone
2. Solvents for pyroxylin .....	alcohol
3. Solvents for resins and rubber .....	xylene
4. Solvents for cellulose ether .....	ethyl acetate
5. Solvents for chlorinated rubber .....	butyl acetate
6. Solvents for synthetic resins .....	isobutyl alcohol
7. Solvents and blending agents for cellulose ester lacquers .....	benzyl alcohol

Use <sup>8</sup>

1. Viscosity changers.

2. Plasticizers.

3. Azeotropic mixtures.

4. Extractants.

5. Degreasers.
6. Solvents for solids.

7. Impregnators.

8. Pharmaceuticals.

9. Carriers for other materials.

Chemical Composition

I. ORGANIC SOLVENTS	EXAMPLE
1. Aliphatic hydrocarbons .....	hexane
2. Aromatic hydrocarbons .....	benzene
3. Hydrogenated hydrocarbons .....	tetralin
4. Terpene hydrocarbons .....	oil of turpentine
5. Halogenated hydrocarbons .....	trichloroethylene
6. Alcohols .....	alcohol
7. Aldehydes .....	furfuryl aldehyde
8. Acids .....	butyric acid
9. Esters .....	ethyl acetate
10. Glycols and glycol derivatives .....	glycol
11. Ketones .....	acetone
12. Ethers .....	ethyl ether
13. Acetals .....	dimethylacetal
14. Nitrogen compounds .....	ethanolamine
15. Sulfur compounds .....	carbon disulfide
16. Solvents of secret composition .....	proprietary solvents <sup>9</sup>

II. INORGANIC SOLVENTS

1. Water .....	water
2. Liquefied gases .....	liquid ammonia
3. Molten metals .....	molten iron
4. Fused salts .....	fused cyanides
5. Gases .....	nitrogen

<sup>8</sup> Wenzel, *Zentr. Gewerbehyg. Unfallverhüt.* **25**, 217 (1938).  
<sup>9</sup> A. D. Brandt, W. J. McConneli, and R. H. Flinn, *U. S. Pub. Health Repts.* **61**, 132 (1946).

*Chemical Structure*<sup>10</sup>

1. Pyroxylin solvents (ingredients of a lacquer or lacquer thinner that are directly responsible for the dispersion of the nitrocellulose to form mobile sols or colloidal solutions):  
e.g., ketones, ethers, esters, and ether-alcohols.
2. Couplers (liquids which, when added to solvents in relatively small amounts, increase the tolerance of the solvent mixture for diluents):  
e.g., alcohols, water.
3. Diluents (relatively inexpensive liquids which are blended with pyroxylin solvents and couplers to produce thinner mixtures of improved properties):  
e.g., hydrocarbons

*Behavior Toward Magdala Red*<sup>11</sup>

1. Compounds which dissolve Magdala Red with fluorescence at room temperature and which in their original condition redden gray Magdala Red paper and color it throughout.

Alcohols	Aldehydes
Lower Ketones	Turkey Red Oils
Fatty Acids	Phenols

<sup>10</sup> A. K. Doolittle, *Ind. Eng. Chem.* **27**, 1169 (1935).

<sup>11</sup> H. Eichler, *Z. anal. Chem.* **103**, 425 (1935).

Nitrobenzene dissolves Magdala Red with slight fluorescence. The addition of compounds of group 3 usually removes the fluorescence.

2. Substances which do not dissolve Magdala Red at room or higher temperatures and do not react with Magdala paper.

Aliphatic hydrocarbons and their chlorinated derivatives

Aromatic hydrocarbons and their chlorinated derivatives

Fats	Fatty Oils
Carbon Disulfide	Ethereal Oils
Ether	

Mixtures of these substances with ethyl alcohol dissolve Magdala Red with fluorescence.

3. Compounds which dissolve Magdala Red without fluorescence and color Magdala paper red

Aromatic Amines Heterocyclic Bases

In addition there are substances which dissolve Magdala Red only at elevated temperatures with fluorescence. These substances include water, aqueous solutions of fatty acids, and dilute mineral acids of pH 4.

## Chapter II

# SAFE PRACTICES IN THE USE OF SOLVENTS

"Safety . . . is teamwork between management and labor, between foreman and his crew, between operators and maintenance men, between one man and his buddy working alongside of him. It's the company providing the safest equipment and the employees providing the safest attitude."

W. C. Uhl, *Petroleum Processing* 3, 211 (1948).

As is well known, organic solvents are among the most commonly used chemicals in industry today. Some fifty years ago, the number of solvents employed and their relative quantities were rather small. Today, tons of a large variety of alcohols, ethers, ketones, petroleum and coal tar distillates, halogenated hydrocarbons, etc., are employed each year in all kinds of industries, such as lacquer, paint and varnish, plastics, dry cleaning, textile, printing, plating and many others.<sup>1</sup>

While all of these solvents are invaluable to modern industry, it must be recognized that solvents in general, like other chemicals and tools in general, are potentially hazardous. Nevertheless, just as an apparently safe operation or what is considered a non-hazardous chemical may cause accidents and death, so a most dangerous operation and a very toxic chemical may be employed with safety if adequate consideration is given to the proper handling of the potential danger. Thus solvents, even toxic solvents, can be handled with safety.

The search is still on for the "ideal" indus-

trial solvent which does not burn, does not explode, does not cause dermatitis, is not toxic, and dissolves the greatest number of industrially employed inorganic and organic substances, including fats and oils. Until it has been discovered and made commercially available, we must take suitable precautions in the employment of solvents available at present.

According to Gordon,<sup>2</sup> a well-planned safety program for the safe handling of solvents consists of:

1. Identification of hazardous operations.
2. Analysis of the hazards.
3. Engineering controls.
4. Personal protection of employees.
5. Medical protection.
6. Supervision.
7. Employee education.

### IDENTIFICATION OF HAZARDOUS OPERATIONS

Occasionally a hazard has been discovered only after it has caused some more or less serious after-effects, but this is rarely the case today. Nowadays, information on the hazards of commonly employed industrial volatile solvents can be obtained very readily from the

<sup>1</sup> For a comprehensive tabulation of industrial uses of solvents, see T. C. Gregory, *Uses and Applications of Chemicals and Related Materials*. Reinhold, New York, 1939, 1944.

<sup>2</sup> L. Gordon, *Materials & Methods* 24, 905 (1946).

literature, the manufacturers of solvents, local, state and federal industrial hygiene agencies, Underwriters' Laboratories, Factory Mutual Laboratories, some insurance companies, Industrial Hygiene Foundation, American Industrial Hygiene Association, American Medical Association, etc. Suitable plans can then be made for safe handling and proper controls.

It should be kept in mind, however, that American manufacturers often send out samples of new chemical products for experimental purposes before the completion of studies of all significant properties of the new material. In such cases, it is the custom to print an appropriate cautionary statement on the label which usually reads as follows: "The chemical, physical, and toxicological properties of this product have not yet been fully investigated and the handling or use may be hazardous. Exercise due care."

Several large manufacturers have toxicological laboratories which test each new chemical synthesized so that its relative toxicity is known before it is adopted for manufacture on a commercial scale. This knowledge of the relative toxicity of a new synthetic organic chemical permits its classification as to degree of toxicity and hence the precautions to be observed in its utilization.

The initial step should be a thorough survey of the plant to determine which solvents are used, when, where, how much, and how frequently. Such a survey must include all regular operations, the occasional overhauling of equipment, the cleaning of machinery, the disposal of solvent wastes, the storage and distribution of solvents, and the transfer of solvents to different containers and to various departments throughout the plant.

As a rough guide, the following classification of solvents patterned after that of MacGee, Weber, and Senter<sup>3</sup> is designed for laboratory and plant purposes. It classifies the solvents on the basis of their potential health hazard.

<sup>3</sup> A. E. MacGee, L. J. Weber, and C. H. Senter, *J. Am. Oil Chemists' Soc.* **25**, 279 (1948).

- A. 1. Solvents which can be considered relatively harmless or which seldom cause injuries to the workmen's health after long association with them in everyday plant routine:

pentanes	mineral spirits
petroleum ether	ethyl alcohol
petroleum benzine	ethyl chloride
hexanes	ethyl ether
heptanes	ethyl acetate

2. Solvents which, even though considered to be somewhat toxic, because of their low volatility and usual conditions of use are seldom dangerous from a practical point of view:

ethylene glycol	butyl glycol
dibutyl phthalate	

- B. Solvents which can be considered mildly hazardous or which can be endured by workmen for a short time within maximum permissible concentrations without serious disturbances or dangerous after effects:

toluene	trichloroethylene
xylene	perchloroethylene
cyclohexane	ethylene oxide
cumene	hydrogenated cyclic
cycloheptane	naphthas
propyl acetate	tetrahydro-
amyl alcohol	naphthalene
amyl acetate	nitroethane
butyl alcohol	

- C. Solvents which can be considered as definitely hazardous or which cannot be endured by the workmen for even a short time except at extremely small concentrations without possibility of dangerous after-effects or injuring the ability to work:

benzene	formaldehyde
carbon disulfide	phenol
carbon	nitrobenzene
tetrachloride	dimethyl sulfate
methyl alcohol	pentachloroethane
tetrachloroethane	

## ANALYSIS OF THE HAZARDS

In ordinary industrial operations in which organic solvents are involved, the worker may come in bodily contact with the liquid solvent or may inhale some of the vapors, either for a short time or for the whole working period. Although there are solvents which have only a very slight vapor pressure under ordinary conditions and, therefore, give off only low concentrations of vapors under these conditions, there are others which have an appreciable vapor pressure at room temperature and usually are readily recognizable by their odor. These latter solvents are commonly called "volatile" solvents. Typical examples of "nonvolatile" and "volatile" solvents are glycerol and acetone, respectively. It should be recognized that in the case of these volatile solvents there is the added potential hazard of the effect of solvent inhalation. Depending upon the nature of the solvent as well as the human element, exposure to solvents, both volatile and nonvolatile, may or may not cause illness. It has been pointed out that "the health hazard problem of industrial solvents can be separated into two parts, the one consisting of the relatively easy problem of protecting workmen against exposure to solvent liquid and extremely large concentrations of solvent vapor, and the other consisting of the relatively difficult problem of protecting workmen against exposure to comparatively small concentrations of solvent vapor or gas in the laboratory or plant atmosphere." Methods of taking care of these various health hazards are discussed later.

## PHYSIOLOGICAL RESPONSE

When vapors or gases are inhaled, they pass into the general circulation and are distributed to the heart and the central nervous system with a rapidity second only to that which occurs when they are injected into the veins. They can produce either a general toxic action without harm to the respiratory tract or a mixed effect, being generally toxic

and locally irritant. Some vapors or gases act so violently in the upper respiratory system and lungs that their general toxic effects are secondary considerations. With few exceptions, all volatile solvents if inhaled in sufficient concentration for a sufficient length of time are detrimental to health.

Occasionally, because of accidental spillage, carelessness, ignorance, or sabotage, the amount of vapor in the atmosphere may be extremely high and far above the maximum allowable concentration. Such an acute exposure may cause unconsciousness or even death if the individual is not promptly removed to an uncontaminated atmosphere and given proper medical attention.

**Chronic Exposure.**—Chronic exposure, i.e., repeated exposure or exposure for long periods of time to concentrations above the maximum allowable concentration values but below concentrations which cause discomfort rapidly, may first cause mild symptoms such as headache and fatigue, then nausea, intestinal, visual, or mental disturbances, and, finally, injuries to the blood, liver, kidneys, or other organs of the system.

**Classification of Physiological Action.** The physiological action of the industrial solvents is classified by Flury<sup>4</sup> under five main headings:

- (1) General nerve poisons without other distinctly specific poisonous effects; to this group belong the primary alcohols (with the exception of methyl alcohol), ethers, aldehydes, ketones, and certain esters, and benzene.
- (2) Lung poisons or irritants, that is, those substances which induce the phenomenon of inflammation in the tissues with which they come into immediate contact; the principal rep-

<sup>4</sup> K. B. Lehmann and F. Flury, *Toxikologie und Hygiene der technischen Lösungsmittel*. Springer, Berlin, 1938; (translated by) E. King and H. F. Smyth, Jr., *Toxicology and Hygiene of Industrial Solvents*. Williams & Wilkins, Baltimore, 1943. See also Morris B. Jacobs, *The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents*. 2nd Ed., Interscience, New York, 1949.

representatives of this group are the esters of the methyl series and formic acid esters.

- (3) Blood poisons; benzene and its derivatives are the chief examples; however, the glycols are also in this group.
- (4) Liver poisons and metabolic poisons; to this group belong principally the chlorinated hydrocarbons.
- (5) Kidney poisons; representative of this group are tetrachloroethane and the glycols.

Flury also places in a special group such specific nerve poisons as carbon disulfide and trichloroethylene.

The physiological action can also be considered from the point of view of types of action. These are irritant, narcotic or anesthetic, suffocating, and functional injury to the metabolism. The solvents do not always belong to any one type alone but frequently fall into a number of groups.

The effects of inhalation of vapors can be local or remote, acute or chronic. The effects of inhalation are more severe than those of ingestion because the solvent is taken up rapidly by the blood stream and is pumped all over the body, thus making itself felt more readily than would otherwise be possible.<sup>5</sup>

**Dermatitis.**—While inhalation of vapor is the major hazard of solvents, contact of the liquid with the skin is also hazardous because it may result in dermatitis.

Organic solvents cause dermatitis in three ways: First, they dissolve and remove the fatty and sebaceous content of the skin, which then dries and cracks. Thin, dry skins are more likely to be affected than thick, oily ones. Cracks and fissures in the skin may lead to invasion by bacteria and subsequent infection. Second, they actually dissolve the superficial keratin layer and cause erythema and vesiculation. Third, they produce an allergic reaction in which contact with small amounts may cause severe generalized dermatitis. Some of the industries in which der-

matitis attributable to solvents is relatively common are the airplane (use of dopes), painting (use of thinners), degreasing, electroplating, and printing and lithographing industries.

The ten chief classes of solvents<sup>6</sup> which may cause dermatitis are listed below:

- (1) Petroleum derivatives: benzene, kerosene, gasoline, naphtha, ligroin, Varsol, Stoddard solvent.
- (2) Coal-tar derivatives: coal-tar naphtha, solvent naphtha, benzene, toluene, cymene, xylene, tetralin, decalin.
- (3) Turpentine groups: turpentine, wood spirit, pine oil, pine needle oil, oil of spike, terpeneol, rosin spirit, tar spirit.
- (4) Alcohols: methyl, ethyl and its denaturants, propyl, butyl, amyl, benzyl, and cyclohexyl.
- (5) Chlorinated hydrocarbons: methylene chloride, chloroform, carbon tetrachloride, dichloroethylene, trichloroethylene, tetrachloroethane, pentachloroethane, perchloroethylene, monochlorobenzene, dichlorobenzene.
- (6) Esters: methyl acetate, ethyl acetate, butyl acetate, methyl formate, ethyl formate, butyl formate, amyl formate.
- (7) Ketones: acetone, methyl acetone, ethyl methyl ketone, methylcyclohexanone.
- (8) Glycols.
- (9) Nitroparaffins: nitromethane, nitroethane, 1- and 2-nitropropane.
- (10) Carbon disulfide.

#### PREVENTION OF EXPOSURE

As outlined by Moskowitz,<sup>7</sup> intoxication by inhalation may be prevented by the follow-

<sup>6</sup> L. Schwartz, U. S. Pub. Health Service, *Bull.* 249 (1939); *Ind. Hyg. Newsletter, Supplement 1*, Nov. 1947.

<sup>7</sup> S. Moskowitz, N. Y. State Dept. Labor, *Monthly Rev., Div. Ind. Hyg. & Safety Standards* 26, No. 9, 37-9 (1947).

<sup>5</sup> P. Drinker, *Ind. Med.* 4, 235 (1935).

ing methods of controlling exposures to toxic substances :

1. Substituting less toxic materials for those of greater toxicity wherever possible.
2. Isolation, either in space or time.
3. Change of process or operation.
4. Control at point of origin of contaminant, such as use of
  - (a) local exhaust ventilation.
  - (b) wet methods for particulate matter.
5. Dilution of contaminated with uncontaminated air by general ventilation.
6. Good maintenance and good house-keeping.
7. Use of personal respiratory protective devices, such as gas masks and respirators.

Moskowitz points out, however, that, although these methods are arranged numerically, they are not necessarily listed in the order of their importance and are not all applicable to the problem of solvent vapor control.

**Maximum Allowable Concentrations.** For a large number of solvents, the *approximate* limit for daily eight-hour exposure at which the vapor may become a hazard has been determined. This approximate limit, a guide for providing safe working conditions, is called the maximum allowable concentration (= M.A.C.), or threshold limit. It is expressed as parts of vapor per million parts of air, by volume. Much work has been done by a large number of investigators in determining the threshold limits for many of the solvents. In some cases these figures are well established, whereas in others more work needs to be done. Recent possible safe concentration limits of exposure to various vapors as taken from several sources are shown in Table 2.

The threshold limits given in the table should be taken as an approximate guide only. People will always differ in their response to a contaminated atmosphere; like-

wise, under different conditions the same person may respond differently to the very same atmosphere. For these reasons it is next to impossible to fix absolute limits below which all persons are safe and above which all persons will be affected. These facts account for the appreciable differences in the probable safe concentration limits of exposure to gases and vapors in the atmosphere, shown in the last table.

Various codes and standards have been adopted or suggested. Of particular importance are the state or municipal codes based either in part or entirely on federal studies or the publications of the American Standards Association. However, as pointed out by Mallette:<sup>7a</sup>

"Most of these threshold limits are based upon levels above which physiologically damaging effects are produced. Many of them are based upon animal experimentation and have the limitations of that method. It is not always possible to carry over results from animal experiments to human application. For that reason a margin of safety is always provided. For example, in the establishment of the maximum permissible concentrations for acrylonitrile, a common constituent of one of the synthetic rubbers, the limit established is half of that which produced deleterious effects upon the most susceptible species, the dog. However, recent experience indicates that this figure may be unnecessarily low so far as human exposure is concerned."

#### ENGINEERING CONTROLS

Illness from exposure to solvents may be avoided by designing equipment in such a way that the worker (1) is not subjected to vapor concentrations above the safe limit during operations, (2) does not become subjected to high concentrations of solvent vapor in occasional or intermittent operations, and (3) does not have his skin wetted by the liquid solvent.

<sup>7a</sup> F. S. Mallette, *What's New in Industrial Hyg.* 4, No. 3, 9 (1947).

TABLE 2. PROBABLE SAFE CONCENTRATION LIMITS OF EXPOSURE FOR VAPORS<sup>a</sup>

Substance	1		2	3	4	5	6	7	8	9
	Gov. hygienists and N. Y. ppm.	mg./l.	ASA, ppm.	Calif., ppm.	Conn., ppm.	Cook, ppm.	Mass., ppm.	Ore- gon, ppm.	Utah, ppm.	Wis., ppm.
Acetaldehyde.....	200	0.360	...	200	.....	200	.....	.....	.....	.....
Acetic acid.....	10	0.025	...	10	.....	10	.....	.....	.....	.....
Acetic anhydride.....	5	0.021	...	.....	.....	.....	.....	.....	.....	.....
Acetone.....	500	1.186	...	1,000	.....	500	500	500	200	.....
Acrolein.....	0.5	0.001	...	0.5	.....	0.5	.....	1	3.3	.....
Acrylonitrile.....	20	0.043	...	20	.....	20	.....	20	.....	.....
Allyl alcohol.....	.....	.....	.....	15	.....	.....	.....	.....	.....	.....
Allyl chloride.....	.....	.....	.....	(0.035 mg./l.) 50	.....	.....	.....	.....	.....	.....
Amyl acetate.....	200	1.064	...	200	.....	200	200	400	400	400
Aniline.....	5	0.019	...	5	.....	5	5	5	5-7	5
Benzene (benzol).....	35	0.111	100	100	100	100	35	75	75-100	75
Benzine.....	.....	.....	.....	1,000	.....	500	.....	.....	1,000	.....
n-Butyl acetate.....	200	0.948	...	200	.....	200	200	.....	.....	400
n-Butyl alcohol (butanol)...	100	0.152	...	100	.....	50	50	.....	100	.....
Butyl methyl ketone (methyl butyl ketone).....	100	0.409	...	200	.....	200	.....	.....	.....	.....
Carbon disulfide.....	20	0.062	20	20	20	20	20	20	20	15
Carbon tetrachloride.....	50	0.315	...	100	100	100	50	50	100	100
2-Chlorobutadiene (chloro- prene).....	25	0.091	...	25	.....	25	.....	.....	83	.....
Chloroform.....	100	0.487	...	100	.....	100	.....	.....	100	.....
1-Chloro-1-nitropropane....	20	0.101	...	20	.....	20	.....	.....	.....	.....
Cresols and cresylic acid....	5	0.022	...	5	.....	.....	.....	.....	.....	.....
Cyclohexane.....	400	1.376	...	400	.....	400	.....	.....	.....	.....
Cyclohexanol.....	100	0.409	...	100	.....	100	.....	.....	.....	.....
Cyclohexanone.....	100	0.401	...	100	.....	100	.....	.....	.....	.....
Cyclohexene.....	400	1.340	...	400	.....	400	.....	.....	.....	.....
o-Dichlorobenzene.....	50	0.301	...	75	.....	75	75	75	.....	75
1,1-Dichloroethane (ethylidene dichloride)...	100	0.401	...	100	.....	100	.....	.....	.....	.....
1,2-Dichloroethane (ethylene dichloride).....	75	0.301	...	100	.....	100	75	100	100	100
1,2-Dichloroethylene.....	200	0.794	...	100	.....	100	.....	.....	100	.....
Dichloroethyl ether.....	15	0.083	...	15	.....	15	15	.....	15	15
Dichloromethane (methylene chloride).....	500	1.740	...	500	.....	500	.....	.....	.....	.....
1,1-Dichloro-1-nitroethane..	10	0.059	...	.....	.....	10	.....	.....	.....	.....
1,2-Dichloropropane (propylene dichloride)....	75	0.347	...	.....	.....	.....	.....	.....	.....	.....
Diethylene glycol monoethyl ether (Carbitol).....	.....	.....	.....	50	.....	.....	.....	.....	.....	.....
Diethylamine.....	25	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dimethylaniline.....	5	0.025	...	5	.....	5	.....	5	.....	.....
Dioxane.....	100	0.360	...	100	.....	500	.....	.....	.....	.....
Ethyl acetate.....	400	1.440	...	400	.....	400	400	.....	.....	.....
Ethyl alcohol.....	1,000	1.881	...	1,000	.....	1,000	.....	.....	.....	.....
Ethylamine.....	25	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ethylbenzene.....	200	0.868	...	200	.....	200	.....	.....	.....	.....
Ethyl bromide.....	200	0.900	...	400	.....	400	.....	.....	1,700	.....
Ethyl chloride.....	1,000	2.640	...	1,000	.....	5,000	.....	.....	20,000	.....

<sup>a</sup> After Morris B. Jacobs, *Analytical Chemistry of Industrial Poisons, Hazards, and Solvents*. Interscience, New York, 1949.

TABLE 2. *Continued*

Substance f	1		2	3	4	5	6	7	8	9
	Gov. hygienists and N. Y. ppm.	mg./l.	ASA., ppm.	Calif., ppm.	Conn., ppm.	Cook, ppm.	Mass., ppm.	Ore- gon, ppm.	Utah, ppm.	Wis., ppm.
Ethylene chlorohydrin.....	5	0.016	...	10	.....	10				
Ethylene glycol monobutyl ether (butyl Cellosolve)...	200	0.966	...	200	.....	200				
Ethylene glycol monoethyl ether (Cellosolve).....	200	0.736	...	200	.....	200	.....	...	.....	500
Ethylene glycol monoethyl ether acetate (Cellosolve acetate).....	100	0.540	...	200	.....	100				
Ethylene glycol monomethyl ether (methyl Cellosolve).	25	0.078	...	100	.....	100	.....	...	<25	
Ethylene glycol monomethyl ether acetate (methyl Cellosolve acetate).....	25	0.121	...	100	.....	100				
Ethylene oxide.....	100	0.180	...	100	.....	100	.....	...	<250	
Ethyl ether.....	400	1.212	...	1,000	.....	500	400	400	400	400
Ethyl formate.....	100	0.303	...	200	.....	200				
Ethyl methyl ketone (2-buta- none).....	250	0.735	...	200	.....	200	300			
Ethyl methacrylate.....				400 (1.864 mg./l.)						
Ethyl silicate.....	100	0.851	...	100	.....	100				
Gasoline.....	500	2.0	...	1,000	1,000	500	1,000	500	1,000	1,000
Heptane.....	500	2.045	...	500	.....	500				
Hexane.....	500	1.760	...	1,000	.....	1,000				
Isoamyl alcohol.....	100	0.360	...	100	.....	100	200	...	55.6	
Isobutyl methyl ketone (methyl isobutyl ketone)...	100	0.409	...	200	.....	200				
Isophorone.....	25	0.041	...	25	.....	25				
Isopropyl alcohol.....	400	1.022	...	400	.....	400				
Isopropyl ether.....	500	2.0	...	500	.....	500				
Mesityl oxide.....	50	0.201	...	50	.....	50				
Methyl acetate.....	200	0.606	...	100	.....	100				
Methyl alcohol (methanol)...	200	0.262	200	200	200	200	200	100	100-200	200
Methyl bromide.....	20	0.078	...	20	.....	20	.....	35	50	
Methyl chloride.....	100	0.207	...	200	.....	200	.....	100	500	
Methylcyclohexane.....	500	2.005	...	1,000	.....	1,000				
Methylcyclohexanol.....	100	0.466	...	100	.....	100				
Methylcyclohexanone.....	100	0.499	...	100	.....	100				
Methyl formate.....	100	0.255	...	400	.....	400				
Methyl methacrylate.....				500 (2.045 mg./l.)						
Methyl propyl ketone (pen- tanone).....	200	0.704	...	400	.....	400				
Methyl sulfate.....	1	0.005	...	1	.....	1				
Monochlorobenzene.....	75	0.345	...	75	.....	75	75	...	75	75
Mononitrotoluene.....	5	0.028	...	5	.....	5	.....			
Naphtha (coal tar, solvent)...	200	ca. 0.8	...	100-200	.....	100-200	200	200		
Naphtha (petroleum).....	500	ca. 2.0	...	500	.....	500	.....	500	5,000	
Nickel carbonyl.....	1	0.007	...		.....					
Nitrobenzene.....	1	0.005	...	5	.....	5	5	5	1-5	5
Nitroethane.....	100	0.307	...	200	.....	200				
Nitroglycerin.....	0.5	0.005	...	0.5	.....	0.5				
Nitromethane.....	100	0.250	...	200	.....	200				

TABLE 2. *Continued*

Substance	1 Gov. hygienists and N. Y. ppm. mg./l.		2 ASA, ppm.	3 Calif., ppm.	4 Conn., ppm.	5 Cook, ppm.	6 Mass., ppm.	7 Oregon, ppm.	8 Utah, ppm.	9 Wis., ppm.
2-Nitropropane.....	50	0.182								
Octane.....	500	2.330	...	500	.....	500				
Pentane.....	1,000	2.94	...	5,000	.....	5,000				
Phenol.....	5	0.019	...	5						
Phosgene.....	1	0.004	...	1	1	1	.....	1	1	1
Phosphorus trichloride.....	0.5	0.0028	...	0.5	.....	0.5	.....	...	0.7	
Propyl acetate.....	200	0.834	...	200	.....	200				
Stoddard solvent.....	500	ca. 2.0	...	500	.....	500				
Styrene monomer.....	200	0.850	400	400	400	400	400	400		
Sulfur monochloride.....	1	0.006	...	1	.....	1				
1,1,2,2-Tetrachloroethane...	5	0.034	...	10	.....	10	5	10	10	10
Tetrachloroethylene.....	100	0.679	...	200	.....	200	200	200	200	200
Toluene (toluol).....	200	0.752	200	200	200	200	200	200	200	200
Toluidine.....	5	0.022	...	5	.....	5				
Trichloroethane.....				50 (0.272 mg./l.)						
Trichloroethylene.....	100	0.537	200	200	.....	200	200	200	200	200
Trichloromonofluoromethane	1,000	5.62	...	.....	.....	10,000				
Turpentine.....	100	ca. 0.60	...	100	700	200	200	200	200	200
Vinyl chloride.....	500	1.280	...	1,000	.....	1,000	.....	...	500	
Xylene (xylol).....	200	0.868	200	200	200	200	200	200	200	200

## References:

1. Committee on Threshold Limits, American Conference of Governmental Industrial Hygienists, *Arch. Ind. Hyg. and Occupational Med.* **6**, 178 (1952); revision adopted April, 1952; New York State, Dept. Labor, Div. Ind. Hyg., "Supplement to Industrial Code Rule #12. — List of Harmful Substances for Which Maximum Allowable Concentrations Are Available," Oct. 1, 1952. These values are not official; they are used by the Div. Ind. Hyg. as a guide.
2. American Standards Association, *Am. Standards* through 1948.
3. State of California, Div. Ind. Safety, Dept. Ind. Relations, "Dusts, Fumes, Mists, Vapors, and Gases," 1948.
4. State of Connecticut, Dept. Health Sanitary Code, *Regulation* 280, 1948.
5. W. A. Cook, "Maximum Allowable Concentrations of Industrial Atmospheric Contaminants," *Ind. Med.* **14**, 936 (1945).
6. Massachusetts Dept. Labor Industries, Div. Occupational Hyg., "Maximum Allowable Concentrations," 1948; the October, 1951, revision (Bulletin No. 600) contained the following changes or additions: acetic acid 10, acrolein 0.5, carbon tetrachloride 35, chloroform 100, cyclohexane 400, dichlorobenzene 50, ethyl alcohol 1000, ethyl silicate 100, methyl bromide 20, methyl chloride 100, methylene chloride (dichloromethane) 250, isobutyl methyl ketone 100, nitrobenzene 1, nitropropane 25, propylene dichloride 75, styrene monomer 200, tetrachloroethylene 150, trichloroethylene 150, in ppm.
7. Oregon State Board of Health, "Rules and Regulations for the Prevention and Control of Occupational Diseases," 1945.
8. Utah Dept. Health, Ind. Hyg. Div., "Useful Criteria in the Identification of Certain Occupational Health Hazards," 1945.
9. Industrial Commission of Wisconsin, "General Orders on Dusts, Fumes, Vapors, and Gases," 1947.

These safety features are accomplished best by using entirely enclosed equipment wherever possible. If this cannot be done, then partially enclosed equipment should be employed (as in degreasing and similar operations) so that the vaporized solvent is condensed and thus its escape into the breathing atmosphere in the workroom is prevented. For small operations involving

solvents, hooded exhausts, ventilated work tables with lateral exhaust, portable blowers or exhaust units, and similar devices should be used.<sup>8</sup> While for such small solvent op-

<sup>8</sup> For more complete discussions of suitable equipment, see such texts as A. D. Brandt, *Industrial Health Engineering*, Wiley, New York, 1947; F. A. Patty, *Industrial Hygiene and Toxicology*, Interscience, New York, 1948; J. M. DallaValle, *Industrial Environment and Its Control*, Pitman, New York, 1948.

erations localized ventilation is usually the best means of controlling the inhalation of solvent vapors, it is sometimes satisfactory to carry out these operations in a room equipped with good general ventilation or by doing the work outdoors. In such cases, care should be taken that the vapors are blown away from and not toward the worker.

In the case of flammable solvents, it is occasionally possible, by the addition of a non-flammable solvent, to reduce fire and explosion hazards, but these hazards are not entirely eliminated by such admixing. For this reason, whenever a flammable solvent is employed, the ventilating equipment must be of fire-safe design.

For best results, a ventilating system should be designed and installed with the aid of a ventilating engineer. In many states, as in New York State, representatives of the Division of Industrial Hygiene can be of great assistance in such matters. Once the ventilating system has been installed, care should be taken to see to it that its usefulness is not impaired by the improper use of fans, windows, etc. Furthermore, in the use of special machines (such as degreasing machines) which are provided with their own mechanical safeguards against excessive vapor contamination of the breathing atmosphere, such safeguards may be nullified by the improper operation of the machine.

### CHEMICAL CONTROLS

As a safeguard against both mechanical and human failures, it is necessary to check the adequacy of the entire system regularly by chemical analysis of the atmosphere at potentially hazardous spots. A number of texts have appeared which describe suitable methods of conducting such analyses.<sup>9, 10, 11, 12, 13</sup>

<sup>9</sup> Morris B. Jacobs, *The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents*. Interscience, New York, 1949.

<sup>10</sup> A. S. Zhitkova and, S. I. Kaplun, and J. B. Ficklen, *Poisonous Gases*. Service to Industry, Hartford, 1936.

### FLAMMABILITY RATINGS AND CONTROL

In addition to health hazards, flammable solvents present the hazard of fires and explosions. Underwriters' Laboratories flammability ratings of some commonly used industrial solvents are given in Table 3.

TABLE 3. FLAMMABILITY RATINGS OF COMMON SOLVENTS<sup>a</sup>

(According to Underwriters' Laboratories)

Ethyl ether.....	100
Benzine.....	95-100
Benzene.....	95-100
Gasoline.....	95-100
Petroleum ether.....	95-100
Acetone.....	90
Toluene.....	75-80
Ethylene dichloride.....	60-70
Turpentine.....	40-50
Kerosene.....	40
Trichloroethylene.....	1-2
Carbon tetrachloride.....	0
Tetrachloroethane.....	0
Tetrachloroethylene.....	0

<sup>a</sup> B. C. Hutchins, *Pacific Factory* 65, No. 3, 48 (1946).

In this table, the flammability ratings of solvents are stated in units on an arbitrary scale of points in which the flammability of ethyl ether and of carbon tetrachloride are given as 100 and 0 respectively.

**Fire Precautions.**—Where flammable solvents are employed, other precautions, according to Gordon,<sup>14</sup> which must be observed to reduce fire and explosion hazards are as follows:

1. All flames, smoking, and so on, must be eliminated.
2. All sources of sparks must be removed. Nonsparking shoes should be used; and

<sup>11</sup> J. B. Ficklen, *Manual of Industrial Health Hazards*. Service to Industry, Hartford, 1940.

<sup>12</sup> W. J. Burke, S. Moskowitz, J. Siegel, B. H. Dolin, and Ch. B. Ford, *Industrial Air Analysis*. Division of Industrial Hygiene, New York State Department of Labor, New York, 1943.

<sup>13</sup> J. Bernsohn, O. W. Boies, A. L. Coleman, R. M. Elrick, E. Glanz, A. E. Goss, L. Press, R. A. Schaefer, and G. H. Vance, *Methods for Determining Toxic Substances in Industrial Atmospheres and Materials*. Connecticut State Department of Health, Hartford, 1947.

<sup>14</sup> L. Gordon, *Materials & Methods* 24, 905 (1946).

- fan blades and tools should be of non-ferrous materials.
3. In spray booths, the booth, floor, baffles and all other parts of the system must be constructed of fire-resistant materials.
  4. Surfaces of walls, and so on, should be smooth to facilitate routine cleaning.
  5. All electric lights, wiring and other electrical equipment must meet the requirements of the National Electric Code, for such locations.
  6. All equipment for handling flammable solvents, including funnels and portable containers when the latter are being filled or emptied, should be electrically grounded.
  7. Main supplies of solvents should be stored in a fireproof storage building, and all mixing should be done in this building.
  8. Fire extinguishers, of types approved by the Underwriters' Laboratories or Factory Mutual Laboratories for the class of hazard concerned, should be provided as protection against incipient fires. Built-in fire extinguishing equipment is needed to safeguard specific hazards which are of such size as to be beyond the capacity of hand fire extinguishers, as well as to afford general building protection.

**Classification of Fires.**—It should be realized that fires are not all alike; they differ not merely in size but also in the nature of the burning material. Depending on the characteristics of the fuel, three general classes of fires have been recognized. In accordance with this classification:<sup>15</sup>

*"Class A Fires* are defined as incipient fires on which the quenching and cooling effect of quantities of water is of first importance, i.e., incipient fires in ordinary combustible materials, such as wood, paper, textiles, rubbish, etc.

*"Class B Fires* are defined as incipient fires on which the blanketing or smothering effect of the extinguishing agent is of first importance, i.e., fires in small quantities of rapidly burning material, such as gasoline, oils, or greases in vats or other open vessels or on floors.

*"Class C Fires* are defined as incipient fires in electrical equipment where the use of a nonconducting extinguishing medium is of importance."

It can readily be seen that solvent fires belong to the Class B type of fires. Various types of fire extinguishers have been developed in this country and elsewhere to handle such fires. Among them are the vaporizing liquid, air foam, chemical foam, carbon dioxide and dry powder type fire extinguishers.

"Approved" fire extinguishers marketed in this country are examined and approved by various, impartial, approved organizations such as the Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago 11, Ill.; Factory Mutual Laboratories, 184 High Street, Boston 10, Mass., and various government bureaus. For compilations of "approved" fire extinguishers as well as the names and addresses of all manufacturers of fire extinguishers approved by approval bodies, see "List of Inspected Fire Protection Equipment and Materials" published by the Underwriters' Laboratories, Inc., as well as "List of Approved Equipment" published by the Factory Mutual Laboratories.

The rules that have been quoted<sup>16</sup> were found to be of considerable help by large-scale users of flammable solvents in reducing losses from fires and explosions. They should be equally helpful to others who may use small amounts of flammable solvents.

#### PERSONAL PROTECTION

Where the use of volatile solvents is restricted to completely enclosed equipment,

<sup>15</sup> *List of Inspected Fire Protection Equipment and Materials*. Underwriters' Laboratories, Inc., Chicago, 1949.

<sup>16</sup> L. Gordon, *Materials & Methods* **24**, 905 (1946).

there is very little chance for the occurrence of skin irritation. However, in operations such as dipping by hand, wiping, or filling containers with solvents, there may be repeated or even frequent contact of the solvent with the skin. In all cases, solvents should be employed in such a way that the liquid solvent does not wet the hands or other parts of the body. Brushes, swabs, or sprays should be employed if greases or oils are to be removed manually; baskets and hoists should be used for dipping operations.

**Protection Against Inhalation.**—No matter how efficient the engineering controls employed in solvent-using processes, it is frequently advisable to furnish certain workers with personal protective equipment as an additional safeguard. Such personal protective devices should never take the place of adequate engineering controls and should be considered only as supplementary or emergency equipment. These personal protective devices include respirators, protective clothing, and creams.

**Respirator Types.**—The use of respirators is advisable where mechanical ventilation is provided but cannot take care of the problem completely (as in some spray booth operations) or in some small-scale solvent-using operations where the installation of mechanical ventilation is impractical. The use of respirators is of utmost importance in cases such as the cleaning of tanks, manholes, sewers, etc., in which individual workers may be exposed to rather high concentrations of toxic vapors for relatively short periods. The types of respiratory protective devices available at present are classified by Patty<sup>17</sup> as follows:

A. Air Purifying Respirators, Which Purify the Air by Removal of the Contaminant

1. Gas Masks (Canister Type)
2. Chemical Cartridge Respirators
3. Mechanical Filter Respirators (For Dusts, Fumes, Fog or Mist)

B. Atmosphere-Supplying Respirators

1. Supplied-Air Respirators
2. Self-Contained- or Oxygen-Supplying Equipment
3. Newly Developed Air- or Oxygen-Supplying Devices

C. Unapproved Equipment

Some of these respiratory protective devices used in handling solvents are discussed briefly below.

1. The *canister type respirator* or "gas mask" filters the vapor through a canister filled with a chemical of the proper type to remove that particular vapor. The chemicals usually employed to adsorb vapors of organic solvents from the atmosphere are activated charcoal, silica gel, alumina, or some other special gas- or vapor-adsorbing chemicals. The canister should be replaced whenever the adsorbent begins to become exhausted. The canister type of respirator should not be employed where the vapor concentration in the breathing atmosphere is or may become higher than 2 per cent.

2. The "*supplied-air*" type respirator generally supplies air through a 1-inch hose line from a source free from vapors. Such a respirator should be used where the vapor concentration is high, for example, in tank cleaning. If the distance from which the uncontaminated air must be brought is longer than 25 feet, then a manually operated blower must be used to force the fresh air through the hose. Occasionally a source of compressed air is used to bring air into the respirator through a 1/2-inch hose. However, this source of air should be used only if no other means is available, because of the possible danger of failure of the compressed air supply. When cleaning tanks, workers should not only be equipped with suitable respirators but should be provided with life lines, and watchers should be stationed outside of the tanks to guard the workers inside until the completion of the job.

3. The "*self-contained*" respirator carries its own supply of oxygen or supplies oxygen

<sup>17</sup> F. A. Patty, *Industrial Hygiene and Toxicology*. Interscience, New York, 1948.

by means of a chemical reaction which takes place while the wearer of the respirator breathes. The former is more cumbersome and more difficult to wear than the latter. "Self-contained" respirators are customarily employed for rescue work and by people who have the necessary training and experience with their use. They can be used for a limited period only.

*Precautions in Use of Respirators.*—Before any kind of respiratory protective device is used, extreme care should be taken to see that the particular respirator chosen is suitable, in good condition, and the best one for the specific purpose. Some of the important questions which must be considered and checked are the following:

1. Can any other methods of control be employed which would make the use of a respiratory protective device unnecessary?

2. What are the advantages, limitations, and disadvantages of the particular respirator suggested for the specific application?

3. Is this respirator of such a nature that it will protect adequately against all potential health hazards of the contaminating material, as well as other chemicals that may be present or may be produced during the exposure?

4. Has the type to which this particular respirator belongs been approved by the United States Bureau of Mines and does it appear in the "List of Respiratory Protective Devices Approved by the Bureau of Mines," published by the Pittsburgh Experimental Station of the United States Bureau of Mines?

5. What is the approximate concentration of the toxic vapor in the contaminated atmosphere?

6. How long will the wearer of the respirator be exposed to this contaminated atmosphere?

7. What kind of work and how much needs to be done in the contaminated atmosphere?

8. Does exposure to the contaminated at-

mosphere represent a serious hazard, either immediately on exposure or sometime afterwards?

9. Has the respirator been cleaned and sterilized?

10. Have all the parts of the respirator been checked carefully by a competent inspector and found to be in perfect operating condition?

11. Has the potential user of this device been properly trained and is he sufficiently experienced with its use so that he knows just what to do in the case of an unexpected emergency?

12. Has at least one more competent person, suitably protected and equipped, been stationed outside of the contaminated atmosphere so that he can be of assistance to the exposed worker, if necessary. Has a pull-rope been attached to the workman before entering unventilated units?

*Approved Respirators.*—The following paragraphs are abstracted from Information Circular No. 7444 "List of Respiratory Protective Devices Approved by the Bureau of Mines," March 1948. They are a guide for the identification of respiratory devices tested and approved by the U. S. Bureau of Mines:

"To provide purchasers and users with a means for identifying approved devices and for procuring the approved parts when making repairs and replacements, the Bureau requires that all devices marketed under the provisions of the approval system of the Federal Bureau of Mines must have an approval label on which is reproduced the seal of the Bureau, the approval number, the name of the manufacturer to whom the approval is issued, and the conditions for which approval is granted. Essential parts of the devices are marked with the approval number. The markings also obligate the manufacturer to maintain the quality of the product and to construct each device, in all its parts, in exact accordance with specifications of the device that the Bureau examined and approved. Any

device that exhibits changes in design or includes any parts that were not in the device approved, regardless of whether the change is made by the manufacturer or the consumer, is not permissible and may not bear the Bureau of Mines approval label.

"The approval label (metal plate) is affixed to self-contained breathing apparatus. Canister-type gas masks bear a label on the case and on each canister, and the approval number is marked on the facepiece and canister harness, for example, 'BM-1400.' Type A (hose mask) and type B (special hose mask without blower) supplied-air respirators have the approval label on their cases or containers, and the approval number is marked on the air-supply arrangement, air-supply line, facepiece, and harness. Type C (air-line respirator) and type CE (abrasive-blasting respirator) have the approval label on their cases (if any) or on a special sheet with instructions for use of the device; and the approval number is marked on the air-supply line, respiratory-inlet covering (facepiece, hood, or helmet), and harness. The containers of dispersoid respirators and the replacement-filter units bear approval labels, and the approval number is marked on the facepiece and each filter unit. The filter units also bear a marking that designates the type of particulate matter for which they are approved, as pneumoconiosis-producing and nuisance dusts, toxic dusts, and fumes."

#### **Protection Against Dermatitis.—**

Where manual handling of the solvent cannot be avoided, the occurrence of dermatitis is a distinct possibility. Predisposing causes of such occupational dermatoses are such factors as age, sex, race, perspiration, physical well-being, skin disease, personal cleanliness, allergic tendency, as well as atmospheric conditions and the amount and type of clothing worn during the exposure. The occurrence of dermatitis may be prevented by: (1) the use of suitable protective gloves, sleeves, and aprons, (2) the use of solvent-resistant creams on face or neck, (3) adequate wash-room facilities provided with liberal amounts

of effective but not harsh cleansing agents as well as suitable lubricating creams.

*Protective Wearing Apparel.*—Protective gloves, sleeves, aprons, etc., should be made from suitable synthetic resins or plastic-coated cloth which is not dissolved or decomposed by the organic solvent involved. If the use of gloves is impractical, then the hands can be protected with an ointment containing a water-soluble base or with glycerol. Thorough cleaning with mild soap and water at the end of each working period, followed by the use of a bland lanolin ointment, is of utmost importance in preventing and eliminating skin dryness and dermatitis. However, cleaning the hands with an organic grease solvent should never be allowed.

*Protective Ointments and Barrier Creams.*—Schwartz<sup>18</sup> divides protective ointments and barrier creams against occupational dermatoses into six classes:

(1) The simple vanishing-cream type, which fills the pores with soap and facilitates the removal of soil when washing after work.

(2) The type that leaves a thin film of a resin or wax on the skin and thus prevents the irritant from touching the skin. This class may be subdivided into (a) water-soluble films, and (b) water-insoluble films. They may be in the form of ointments, emulsions, or solutions. This class of protectives is sometimes called the "invisible glove" type. The water-soluble film helps to protect against the volatile solvents and water-insoluble allergens such as TNT and tetryl. The water-insoluble resins and waxes are used to protect against water-soluble irritants. Shellac, benzoin, and nitrocellulose are the most frequently used resins in this form of protective. The water-soluble films used in protecting against water-insoluble allergens contain methyl cellulose, Irish moss, sodium silicate, tragacanth, acacia, or casein.

(3) Protective ointments that cover the skin and fill the pores with a harmless fat, which repels water-soluble irritants and prevents entrance into the pores of harmful petroleum oils, greases, and coal-tar derivatives, are used as protectives against cutting oils, greases, creosote, pitch, etc. They consist mainly of lanolin

<sup>18</sup> L. Schwartz in F. A. Patty, ed., *Industrial Hygiene and Toxicology*, Interscience, New York, 1948.

and sufficient castor oil to make the lanolin spreadable. The addition of a small amount of a wetting agent makes them easily removable with water, and the addition of a small amount of perfume masks the disagreeable odor of lanolin and castor oil.

(4) Protective ointments that contain a non-irritant chemical intended to detoxify the industrial irritant. For instance, such a protective cream against acids may contain soap and magnesium hydroxide intended to neutralize the acid.

(5) Protective ointments that cause inert powders to adhere to the skin, forming a protective covering against skin irritants. The powders may be calamine, zinc oxide, iron oxide, kieselguhr, bentonite, and so forth. The adhesive or binder may be any one of the resins mentioned in the "invisible glove" type of cream. The ointments are of value in protecting against allergenic substances.

(6) Protective applications against photosensitizing substances. These applications contain such physical light screens as methyl salicylate, aesculin, quinine, anthranilates, and tannates.

### SPILLAGE

Occasionally there may be a spill of solvent due to an accident or carelessness. Such spilled liquid should be mopped up immediately by suitably protected workers. Rags or waste used to mop up the spill should be placed in a covered container and then disposed of outdoors or placed under an exhaust until all vapors have been removed. If a large spill has occurred, it may be desirable to evacuate the area until the place has been thoroughly ventilated. Clothing wet with solvent should be removed immediately and dried where no one will be exposed to the vapors. Windows should be opened near the area where the spill has occurred, but care should be taken that the opening of the windows does not interfere with the general ventilating system in operation in the workroom.

### MEDICAL PROTECTION

The complete health program of industrial plants employing organic solvents should include:

- (a) preplacement medical examinations,
- (b) routine medical examinations at regular intervals,
- (c) a first-aid room supervised by a doctor or a nurse.

Alcoholics and people suffering from anemia or kidney or liver diseases are especially susceptible to solvent injury. Their assignment to solvent operations which may endanger their health or lives can be prevented by the preplacement medical examination. Likewise, allergic workmen or people who are supersensitive to certain substances should not be exposed to solvents (either liquid or vapors). As pointed out by Poole,<sup>10</sup> "One of the means of preventing industrial accidents is to select workers with at least the minimum physical capacity for the job. This means that they must be examined to determine whether or not they have this ability. Preplacement examinations should be utilized for all employees and not confined to those who are thought to be handicapped or disabled, because a number of disabling conditions would never be obvious to an interviewer and might even be unknown to the employee himself. . . . The goal of selective placement is the proper matching of the limited worker to a job which he can perform without hazard to himself or others." The first-aid department can and should provide emergency treatment, if necessary, in cases of acute solvent poisoning and should secure and maintain records of any physiological effects of solvents such as skin irritation, headache, dizziness, stomach upset, etc.

Workers who, in the course of their regular work, may come in contact with liquid solvent or solvent vapor should be examined medically not only at the time when they are hired but also at regular time intervals afterwards. Such examinations should usually include blood tests, urinalyses, etc. Routine medical examinations made at regular time intervals should (1) detect early

<sup>10</sup> F. E. Poole, *Ind. Hyg. Newsletter* 9, No. 6, 14 (1949).

symptoms of illness or dermatitis due to exposure to solvents, (2) prevent the occurrence of chronic cases due to the action of liquid solvent or its vapor, and (3) prevent secondary infection which may be the after-effects of exposure to solvents, etc.

The medical program, being only one aspect of the whole safety program, should be coordinated with other safety activities. Just as the medical department should be advised of all possible health hazards, changes in operations using solvents, and the introduction of new chemicals, so the detection of illness due to solvents by the medical personnel can give valuable clues to defects in the ventilating equipment or point out the need for re-design of solvent operations. Whenever medical findings should indicate that there are defects in the ventilating equipment (such as leaks, fouling of ventilating ducts, insufficient equipment, etc.) and that the established safety regulations are incomplete or are not observed carefully, there should be a complete re-examination by the safety department of the equipment and the personnel involved.

### SUPERVISION

While a person high in the management of the industrial concern should be responsible for the over-all supervision and the complete coordination of the entire safety program, it is equally important to have others responsible for immediate supervision in individual departments where workers may be exposed to the potential hazard. Thus, one person should be in charge of the storage, distribution, inspection, and repair of the various types of safety equipment; one person should be alert to the changeability of fire hazards resulting from changes in processes or solvents used and should be responsible for inspecting fire-fighting equipment and for checking the observance of safety regulations, etc. Also, in each department one person should be responsible for turning on and off all ventilating equipment, checking

for leaks and breaks in the system, etc. Finally, the foremen in departments which handle solvents should observe the personnel in their charge for early symptoms of illness or skin irritation which may be chargeable to solvents. This is particularly important in the case of inexperienced or new employees.

Particular care should be taken to prevent accidents from the unauthorized use of solvents which may occur even in a well-supervised plant. Thus a worker may decide to use a solvent to clean his clothing, to clean some equipment, his working quarters, etc., without considering the hazard involved. This should be watched for and discouraged at all times. Furthermore, it should always be clearly understood that a given amount of solvent requisitioned and received for a certain *approved* purpose should be used for this purpose and this purpose only.

Another factor is the proper storage and labeling of solvents. All solvents used throughout the plant (except possibly for small amounts used in the chemical laboratories, the first-aid room, etc.) should be stored in suitable metal containers provided with proper closures. Flammable solvents should be kept in self-closing safety cans and stored either outdoors or in fireproof rooms.

Containers filled with solvents should be clearly labeled, giving all necessary precautionary information. As pointed out by Gordon,<sup>20</sup> if the label does not warn the user adequately of potential hazards, the packager of the solvent may lose good will, provoke restrictive legislation, or lay himself open to costly damage suits. The Manufacturing Chemists' Association has recognized that the best method of protecting both the consumer and the producer is a proper system of uniform cautionary labeling for all chemicals. Its Manual L-1 contains general recommendations for the wording of cautionary statements on labels with emphasis on simplicity, brevity, and clarity, while its Manual

<sup>20</sup> L. Gordon, *Chem. Inds.* **60**, 412 (1947).

L-2 gives suggested wording for labels for specific products.

The label should contain the necessary cautionary information recommended by the Manufacturing Chemists' Association, the wording should be clear and well located, and finally it should be clearly printed so that its reading is not discouraged. Two typical labels recommended by the Manufacturing Chemists' Association are shown in Figs. 1 and 2.

## ACETONE

### **DANGER! EXTREMELY FLAMMABLE**

**Keep away from heat or open flame.**

**Use with adequate ventilation.**

**Avoid prolonged breathing of vapor.**

**Avoid prolonged or repeated skin contact.**

FIG. 1. Recommended Acetone Label

## TETRACHLOROETHYLENE [PERCHLOROETHYLENE]

### **CAUTION! VOLATILE SOLVENT**

**Use with adequate ventilation.**

**Avoid prolonged or repeated breathing of vapor.**

**Avoid prolonged or repeated contact with skin.**

**Do not take internally.**

FIG. 2. Recommended Tetrachloroethylene Label

### EMPLOYEE EDUCATION

The efforts of the management of an industrial concern in installing and maintaining an effective safety program for the safe handling of volatile organic solvents can be successful only with the active cooperation of the individual workers in the plant. Such cooperation can be stimulated and encouraged by (1) acquainting the workers with the hazard involved; (2) inviting their active participation in the safety program, such as practice emergency rescue work, fire brigades, safety committees, safety meetings, inside and outside of plant, etc.; (3) get-

ting them to report promptly any failures of equipment, symptoms of illness, etc.; (4) supplying the individual workers with or placing on the bulletin boards well-written and illustrated literature or notices regarding safe practice in the handling of the volatile solvents in use in the plant. As stated by Bonotto,<sup>21</sup> however, "Real instruction not merely a set of rules is meant. The superintendent should make frequent examinations to see if the instructions have been thoroughly digested. Danger of explosion (or of toxicity) must be duly emphasized, but not made an object of exaggerated fear, which gives the impression that the man is powerless. The psychological feeling of the worker should be that he is working in a plant having all the safety factors that science is able to produce and that no known danger will come from that end—the only dangerous part of the plant is the worker himself."

It is a common but erroneous belief that the odor is a very positive indication of the safe or hazardous nature of a breathing atmosphere. Thus it is thought by many people that an odorless atmosphere is always safe to breathe, but that an atmosphere with an unusual odor is hazardous (irrespective, of course, of whether this odor is caused by a gas or a vapor). It should be clearly understood and should be impressed on all people who may become exposed to potentially hazardous atmospheres that there are two important factors to be considered, viz., the effect of the exposure and the warning property as the odor and other symptoms. This fact was brought out most emphatically by Sayers<sup>22</sup> who explained that "... the fact that the hazard to health from contamination of air by a noxious gas depends not only on the potential harmful response attending exposure, but also on the warning properties, which in effect may be termed the accompanying warning response. This warning may be manifested as an odor, taste, irrita-

<sup>21</sup> M. Bonotto, *Oil & Soap* 14, 30 (1937).

<sup>22</sup> R. R. Sayers, *U. S. Bur. Mines, Inform. Circ.* 6439 (1931).

tion of the eyes, nose or throat, or perhaps headache, vertigo, or nausea. These manifestations may be painful and even slightly harmful, but to a much lesser degree than the primary injury of exposure. The warning response mitigates hazards directly in proportion to the degree of intolerability which accompanies injurious exposure, and accordingly its absence augments hazards. This accounts for the fact that the actual health hazards from a non-odorous or non-irritating gas or vapor of comparatively low toxicity sometimes equal or exceed the hazard from a considerably more toxic substance, but one which possesses a marked odor or produces eye, nose, or throat irritation in advance of harmful exposure." Explaining these facts should be a part of employee education.

The mechanism of poisoning by volatile solvents was also studied by Clinton,<sup>23</sup> who conducted experiments on the effects of ammonia and of trichloroethylene vapor on the respiration of human beings. While exposure to 1,000 ppm. of ammonia caused coughing, reduced the depth of inspiration, and brought about restraint of breathing, an atmosphere containing as much as 10,000 ppm. of trichloroethylene had no effect on respiration. (The accepted threshold limits for both substances are the same, viz., 100 ppm.) He points out that gases which do not affect the respiration at their toxic levels are dangerous in view of the fact that human beings will willingly continue to expose themselves to the atmosphere as long as they are not otherwise warned.

Workers participating in solvent operations should be advised that their health can be maintained through their own efforts largely by (a) personal cleanliness, (b) a well-balanced diet, (c) and abstaining from

drinking considerable quantities of alcoholic beverages before handling solvents. As stated by Hutchins,<sup>24</sup> "In the control of both health and fire hazards, employee education is of the utmost importance. Workers must understand the reasons for the practices they are expected to observe and, in particular, that cooperation in the safety program is to their self-interest."

Whenever a solvent is used regularly in a given industrial operation, due precautions are usually taken for its safe use. It is the occasional use of solvents, both in large- and small-scale plants, laboratories, and the home, which causes trouble, because it is the occasional user of solvents who does not appreciate the potential hazards and who is unfamiliar with proper techniques of handling solvents safely. Before using a new solvent or an old solvent in a new application, all important factors should be studied to make certain that the operation planned can be carried out safely. The following check list has been suggested<sup>25</sup>

- (1) Is solvent distribution properly supervised?
- (2) Are solvent operations properly designed?
- (3) Are solvent operations properly supervised?
- (4) Is there protection against solvent vapors?
- (5) Is there protection against dermatitis?
- (6) Is there protection against fire?
- (7) Are solvent containers suitably designed?
- (8) Is equipment properly maintained?
- (9) Are workers informed of hazards and precautions?
- (10) Is medical protection provided?

<sup>23</sup> M. Clinton, Jr., *New Engl. J. Med.* **238**, 51 (1948).

<sup>24</sup> B. C. Hutchins, *Pacific Factory* **65**, 48 (1946).

<sup>25</sup> Anon., *Am. Machinist* **92**, 145 (1948).

## Chapter III

# SOLVENT ACTION AND POWER

The term *solvent action* is defined<sup>1</sup> as "Any process of making substances water soluble; as insoluble phosphates transformed by soil bacteria to the soluble phosphoric acid." In a broader interpretation this term might be understood to be the phenomenon of making a substance soluble in a solvent.

From purely theoretical consideration Lees<sup>2</sup> derived three relationships between composition and viscosity of liquid mixtures. These relationships did not agree with experimentally determined results obtained by Linebarger<sup>3</sup> as well as Thorpe and Rodger.<sup>4</sup> However, Lees' empirical formula—

$$\eta^n = a\eta_1^n + (1 - a)\eta_2^n$$

in which  $a$  represents the proportion by volume of the first component,  $\eta_1$  and  $\eta_2$  represent the viscosities of the pure liquid, and  $n$  represents a constant for a pair of liquids—gives results which show good agreement with data experimentally obtained for mixtures of associated and non-associated liquids. It was pointed out by Baker<sup>5</sup> that for mixtures of alcohols with anisole and phenetole a change from methyl to ethyl alcohol changes the viscosity-concentration curve from one capable of being expressed by Lees' empirical formula to one which

cannot be expressed in this way and that Lees' formula has no theoretical significance. Bingham<sup>6</sup> expressed the view that not viscosities but fluidities are additive, with the exception of those cases in which association or dissociation interferes. When viscosities of mixtures are calculated on such a basis then the results obtained are closer to experimentally obtained data than when they are calculated on the basis that there is an addition law for viscosities.

Relationships between concentration and viscosities of such liquids were studied by Hatschek<sup>7</sup> who considered such mixtures as divided into two classes, viz., suspensoid and emulsoids. For emulsions he derived the formula

$$\eta = \eta_0 \left( 1 + \frac{9}{2f} \right)$$

in which  $\eta$  represents the viscosity of the solvent and  $f$  represents the ratio of volume of disperse phase over total volume. Thus  $\eta$  depends on the amount of solid but does not depend on the size and distance apart of the particles as long as the limits are within those for which Stokes' law is valid. If the increase in viscosity is not in line with this relationship, the dispersed phase must be there in amount far above that quantity which makes possible the free motion of the particles; in such cases Stokes' law does not apply.

<sup>1</sup> J. Grant, *Hackh's Chemical Dictionary*, 2nd ed. Blakiston, Philadelphia, 1944.

<sup>2</sup> C. H. Lees, *Phil. Mag.* [6] 1, 128 (1901).

<sup>3</sup> C. E. Linebarger, *Am. J. Sci.* [4] 2, 331 (1896).

<sup>4</sup> T. E. Thorpe and J. W. Rodger, *J. Chem. Soc.* 71, 36 (1897).

<sup>5</sup> F. Baker, *J. Chem. Soc.* 101, 1409 (1911); 103, 1653 (1913).

<sup>6</sup> E. C. Bingham, *J. Chem. Soc.* 103, 959 (1913).

<sup>7</sup> E. Hatschek, *Z. Chem. Ind. Kolloide* 7, 30 (1910); 8, 34 (1911); 11, 284 (1912).

ply. For emulsoids Hatschek gives the formula

$$\eta = \eta_0 \frac{\sqrt[3]{f}}{\sqrt[3]{f} - 1}$$

in which  $f$  represents the ratio of total volume over volume of dispersed phase. This relationship holds at and above the critical velocity. At very high concentrations, however, of the disperse phase, this relationship does not apply because of a change in the properties of the continuous phase. The relationships are still more complex below the critical velocity.

As both Hatschek's relationships do not account for the high viscosities shown by even dilute solutions of certain grades of nitrocellulose, Baker<sup>8</sup> did not consider that they could be used to express the relation between viscosity and concentration. He found that various concentrations of solutions of cellulose nitrate in a variety of solvents follow the law

$$\eta = \eta_0(1 + ac)^k$$

in which  $a$  and  $c$  are constants depending on the nature of solute and solvent. When comparing a number of solvents the value

$$\frac{d \log \eta}{dc}$$

is the best characteristic. For the same grade of nitrocellulose this constant varies with different solvents; however, generally, they agree with the view that the better the solvent the lower the viscosity.

**True Solutions.**—Certain theories of Hildebrand<sup>9</sup> for solvent action in true solutions are discussed by Doolittle:<sup>10</sup> "According to these views, two classes of liquids are distinguished, referred to as nonassociated and associated liquids. The members of the first group, nonassociated liquids, have low dielectric constants and conform to general

rules concerning surface tensions and heats of vaporization. In this group are included the paraffin hydrocarbons, coal-tar hydrocarbons, and carbon tetrachloride. The members of the other group, associated liquids, have higher dielectric constants and exhibit higher surface tensions and heats of vaporization than would be expected from the generalizations applying to the first group. The associated liquids include such solvents as water, alcohols, ketones, and esters. The evidence indicates that the fundamental distinction between the nonassociated and associated liquids lies in the greater symmetry of the fields of force surrounding the molecules of the liquids of the first group. The fields surrounding the molecules of the associated liquids are considered to be unsymmetrical or polar. The result is that polar molecules have greater attraction for each other, thus producing greater cohesions, surface tensions, and heats of vaporization. It may therefore be visualized that substances having high internal pressures (cohesive forces) would act only as solvents of similar substances because the molecules of a substance of lower internal pressure would tend to be 'squeezed out' by the powerful attractive forces exerted between the molecules of the polar liquid."

**Cellulose Ester Solubility.**—Many theories have been suggested in the past in an attempt to explain why some substances dissolve cellulose esters better than others and why solvent mixtures are frequently better solvents than the individual constituents of the mixture.

Thus Barr and Bircumshaw<sup>11</sup> as well as Byron<sup>12</sup> suggested that one or the other of the solvents in a mixture peptizes the ester and that the increase in solvent power when one solvent is added to another one is caused by a change in the molecular association of the first solvent. They differ, however, in their further speculations. Thus one theory

<sup>8</sup> F. Baker, *J. Chem. Soc.* **103**, 1653 (1913).

<sup>9</sup> J. H. Hildebrand, *Solubility*. Chemical Catalog, New York, 1924.

<sup>10</sup> A. K. Doolittle, *Ind. Eng. Chem.* **27**, 189 (1935).

<sup>11</sup> G. Barr and L. L. Bircumshaw, *Trans. Faraday Soc.* **16**, 99 (1921).

<sup>12</sup> M. L. Byron, *J. Phys. Chem.* **30**, 1116 (1926).

suggests that *polymerized* alcohol is the solvent for nitrocellulose and that the polymerization is increased by the addition of ether. The second theory suggests that *dissociated* alcohol is the solvent and that the dissociation is increased by the addition of ether.

Esselen<sup>13</sup> explains the fact that cellulose acetate is dissolved better by a mixture of alcohol and chloroform than by chloroform alone by the assumption that cellulose acetate which has considerable attraction for hydroxyl groups adsorbs alcohol with the hydroxyl group inside, thus leaving the acetate molecule covered with ethyl groups; it is these ethyl groups which tend to dissolve in the chloroform causing swelling and peptization of the cellulose acetate.

Mardles<sup>14</sup> pointed out that liquids which are solvents for cellulose esters form complexes with the latter. He found also that, because of the fact that there is a rapid decrease in solvent power with ascent in a homologous series, there is a decrease in solvent power with increasing molecular weight and that, therefore, the addition of a liquid to a solvent which tends to simplify the molecular state or to decrease molecular association tends to increase the solvent power of the liquid. This is similar to the theories of Barr and Bircumshaw and of Byron.

The conclusions of Mardles were not accepted by Sheppard, Carver, and Houck<sup>15</sup> who note that, although apparently for cellulose nitrate any increase in the molecular weight of a homologous series decreases the solvent power, this increase in solubility does not hold for some cellulose esters of the higher fatty acids.

McBain,<sup>16</sup> like Mardles, stressed solvation

as an important factor; however, he stated that there is a larger variety of molecules to be attracted to various portions of the cellulose molecule and to solvate it more completely in a mixture of solvents than in a single solvent. McBain felt that any solvent combination which tends to separate a cellulose ester from large aggregates to small particles (the latter with no attraction for another) is a good solvent and forms a sol with little plasticity; he suggested likewise that any liquid which tends to form larger or smaller particles (which still are left with some remaining attraction for another) is not a good solvent. His views of the need for large ramifying aggregates to bring about plasticity are objected to by Hatschek.<sup>17</sup>

Hildebrand's<sup>17a</sup> polar-nonpolar theory of solvent action was used by Highfield<sup>18</sup> to explain the solvent action of mixtures of acetone and water for nitrocellulose; he assumed that in mixtures of maximum solvent strength the acetone-water mixture exhibits the optimum polar characteristics for dissolving nitrocellulose. He showed that nitrocellulose and nitrocellulose solvents contain strongly and weakly polar groups and that mixed liquids are solvents if they contain both classes of groups balanced in suitable proportions irrespective of whether or not the ingredients of the mixture are solvents. He pointed out also that the results of investigations in relationships between the composition of solvent or solute and the viscosity of nitrocellulose sols are in agreement with conclusions reached from solubility considerations.

The views of Highfield were accepted by Sheppard, Carver, and Houck<sup>15</sup> who presented a hypothesis to explain the greater solvent strength of mixtures over that of their pure components. They suggested that this increased solvent strength of certain mixtures of polar solvents (e.g., ether and

<sup>13</sup> G. J. Esselen, Jr., *Ind. Eng. Chem.* **12**, 801 (1920).

<sup>14</sup> E. W. J. Mardles, *J. Soc. Chem. Ind.* **42**, 129T (1923).

<sup>15</sup> S. E. Sheppard, E. K. Carver, and R. C. Houck, *5th Colloid Symposium Monograph*, **1928**, 243.

<sup>16</sup> J. W. McBain, *J. Phys. Chem.* **30**, 239 (1926).

<sup>17</sup> E. Hatschek, *J. Phys. Chem.* **31**, 383 (1927).

<sup>17a</sup> J. H. Hildebrand, *Solubility*. Chemical Catalog, New York, 1924.

<sup>18</sup> A. Highfield, *Trans. Faraday Soc.* **22**, 57 (1926).

alcohol) may be due to the formation of a polar complex between one of the polar liquids and nitrocellulose; this complex in turn renders nitrocellulose soluble in a solvent which is more soluble than the optimum polarity for nitrocellulose alone.

In their discussion of solvent action in the dispersion of nitrocellulose to form colloidal solutions Clayton and Clark<sup>19</sup> ascribe the polarity of the molecule of nitrocellulose to a coordinate linkage between hydroxyl groups and neighboring ester groups within the cellulose ester molecule. Doolittle<sup>20</sup> stated that the "fact that pyroxylin of higher degrees of nitration are decreasingly soluble in polar solvents and increasingly soluble in nonpolar solvents such as chloroform lends credence to this view, although direct proof in this manner is not possible because complete nitration with extinction of all of the hydroxyl groups in the cellulose molecule has not been effected."

**Dye Solubility.**—Solvent action with particular emphasis on dyeing and allied processes has been discussed by Clayton and Clark who noted that "it is not possible in the present state of knowledge to give a logical explanation of the widely varying action of solvents on different substances. The view that like dissolves like is true in so far as it applies to substances of similar classes. This may be interpreted in scientific language by saying that substances having high internal pressures only act as solvents of similar substances; if, therefore, a liquid of low internal pressure, i.e., one whose molecules have little attraction for one another, is added to a liquid of the former type, its molecules will have very little effect on the powerful attractive forces exerted between molecules of the other liquid. Consequently the two liquids will be immiscible. However, definite laws, which will establish the true nature of all kinds of dissolution processes

have yet to be discovered." In large measure the last statement was true in 1953.

The solvent action of various solvents for eosin and tetrabromofluorescein, of hair-dye solvents, and of the blending action of solvents used for cosmetics is discussed by Chadwick and Pears.<sup>20a</sup>

**Mechanism for Resinous Substances.**—Extensive studies of the mechanism of solvent action were carried out by Doolittle<sup>20b</sup> who concluded that two principal equilibria are simultaneously operative in the solution of resinous substances—solvation-desolvation and aggregation-disaggregation—and that the rate of desolvation is substantially fixed at constant temperature while the rate of solvation is a function principally of solvent concentration. From his investigation of solution process, solvation-desolvation equilibrium, aggregation-disaggregation equilibrium, and film formation and plasticization he reached the following conclusions:

"1. In homologous series of solvents the mol concentration of solvent at the dilution ratio end point, called the 'threshold concentration,'  $n_{DR}$ , approaches a minimum value as the molecular weight of the solvent increases. This minimum is independent of the diluent used, provided only that the diluent is a truly nonsolvent, and is an indication of the relative effectiveness of each class of solvents for a given macromolecular substance.

"2. Since lower-molecular-weight solvents of a given class are less effective per mol of solvent than higher-molecular-weight members, it is possible in certain instances to pass out of the solvent region on the low-molecular-weight side of the series. It is always possible, however, to pass out of the solvent region on the high-molecular-weight side because the mol concentration of solvent required to initiate the solution process approaches a fixed minimum value whereas the mol concentration of the pure solvent diminishes continuously as the molecular weight increases.

"3. The logarithm of the relative viscosity of resin solutions of fixed solids content is approximately linear with the reciprocal concentration of solvent except in the neighborhood of the re-

<sup>19</sup> E. Clayton and C. O. Clark, *J. Soc. Dyers & Colourist* **47**, 183 (1931).

<sup>20</sup> A. K. Doolittle, *Ind. Eng. Chem.* **27**, 189 (1935).

<sup>20a</sup> E. Chadwick and G. Pears, *Soap, Perfumery & Cosmetics* **25**, Oct. (1952).

<sup>20b</sup> A. K. Doolittle, *Ind. Eng. Chem.* **36**, 239 (1944).

ciprocal threshold concentration,  $1/n_{DR}$ . In this region the viscosity increases rapidly, the curve becoming asymptotic to  $1/n_{DR}$ . Thus, the threshold concentration may be experimentally determined by either dilution ratio or viscosity methods."

In a later study Doolittle<sup>20c</sup> investigated the influence of molecular size and shape on temperature dependence of solvent ability as judged by measuring the threshold concentration for solvation at different temperatures. A summary of his findings follows:

(1) Temperature dependence of solvent ability in homologous series of solvents is influenced by the molecular weight of the solvent. In general, the members of low molecular weight become better solvents with rising temperature and the members of high molecular weight become better solvents with falling temperature.

(2) The shape of the solvent molecule influences temperature dependence of solvent ability more than its weight. In general, compact molecules have a positive temperature coefficient of solvent ability, whereas extended molecules have a negative temperature coefficient of solvent ability.

(3) Branched molecules are likely to exhibit greater decrease of solvent ability with rise in temperature than their linear isomers, and the amount of such inversion is more pronounced, the greater the linear extension of the branches.

(4) In linear solvent molecules containing multiple active groups, the inversion is greater, the farther removed the active groups are from the ends of the molecule.

(5) Gels involving organic solvents and macromolecular solutes may be made which may be liquefied by heating or by cooling, depending on the choice of the solvent. Solvents having a positive temperature coefficient of solvent ability may ordinarily be used to produce gels that liquefy on heating. Gels that liquefy on cooling may often be made from solvents that show a considerable

negative temperature coefficient of solvent ability.

(6) Linear solvent molecules are generally more effective for use in promoting an abrupt sol-gel transformation than are branched molecules although the latter may often exhibit a greater negative temperature coefficient of solvent ability.

## SOLVENT POWER

Solvent power, diluting power, solvency, and similar expressions indicate the property of solvents to disperse the molecules of a solute or vehicle thereby causing a decrease in viscosity.

According to Bogin<sup>21</sup> the usefulness and value of the volatile materials used in lacquers, both the simple compounds used by the industry as raw materials and the complex solvent mixtures prepared from them, depend on their properties and behavior along the following lines:

1. Rate of evaporation.
2. Solvency relations.
3. Effect on the viscosity of the solutions.
4. Compatibility with resins and other ingredients.
5. Blushing behavior.
6. Flow and orange peel.
7. Stability.
8. Odor, purity, availability, etc.

Some of these factors will be discussed later.

Zeidler and Kreis<sup>22</sup> give these various definitions for solvent power:

1. The ability of disintegrating a substance with more or less large particles (dispersion).
2. The rate of solution (using time as a measure of solvent power).
3. Solution up to a definite concentration (using concentration as a measure of solvent power).

<sup>21</sup> C. D. Bogin, in J. J. Mattiello, ed., *Protective and Decorative Coatings*, Chapter 27, Vol. I. Wiley, New York, 1947.

<sup>22</sup> G. Zeidler and H. Kreis, *Lack- u. Farben—Z.* **1944**, 355.

<sup>20c</sup> A. K. Doolittle, *Ind. Eng. Chem.* **38**, 535 (1946).

4. Ability to dissolve a number of substances.

5. Solvent ability in a mixture with a non-solvent (cutting power).

They point out that for technical purposes the rate of solution (with time as a measure), the ability to dissolve many substances, and relative viscosity rather than absolute viscosity are important factors.

Solvent power is determined by such tests as:

1. Analysis of the solvent.<sup>23</sup>
2. Aniline point and mixed aniline point.<sup>24</sup>
3. Dilution ratio tests with synthetic resins and cellulose nitrate.<sup>25</sup>
4. Kauri-butanol value.<sup>26</sup>
5. Refractive index.
6. Specific dispersion.
7. Surface tension.

One of the earliest studies of solvents of colloidal material was made by Graham<sup>27</sup> who found it difficult to determine the relative solvent power of these solvents, for there appeared to be complete miscibility in some cases.

**Associated Liquids.**—While Dutoit and Aston<sup>28</sup> believed that only associated liquids had the power of ionizing dissolved electrolytes, it was demonstrated later by Walden<sup>29</sup> that all liquids have this power to a certain degree of ionizing electrolytes in solution. This ionizing power is shared by all liquids to varying degrees and is influenced to a large extent by the dielectric constant of the solvent. Furthermore, in the case of solvents of

low dielectric constants the principal factor which influences the ionizing power of such solvents is the chemical nature as shown by Sachanoff<sup>30</sup> and Plotnikoff.<sup>31</sup>

**Dielectric Constant.**—In a series of studies of the factors which govern the solvent power of liquids Walden<sup>32</sup> concluded that there is a connection between dielectric constant of the solvent and its solvent power and that solvents with a high dielectric constant usually have greater solvent powers on normal electrolytes than those with lower dielectric constants. In a later study Walden<sup>33</sup> determined the solubility of tetraethylammonium iodide in water, nitromethane, acetonitrile, nitrobenzene, propionitrile, ethyl alcohol, benzonitrile, acetone, acetophenone, amyl alcohol, paraldehyde, methyl formate, and bromobenzene respectively. He found that the solubility could be related to the dielectric constant of the solvent used in such a way that the expression  $\epsilon\sqrt[3]{\mu}$  is a constant value. In this expression  $\epsilon$  is the dielectric constant of the organic solvent and  $\mu$  is the molecular percentage solubility of the salt, defined by  $\frac{n \times 100}{n + N}$ ,  $n$  and  $N$  being the number of molecules of solute and solvent in the solution respectively. Using the thirteen solvents with dielectric constants from 78 to 5.3 the value of this "constant" varied from 42.8 to 54.8 with a mean value of 48. This entirely empirical expression has some resemblance to other theoretically deduced formulae. Later on Turner and Bassett<sup>34</sup> showed that Walden's expression (1) is not generally valid, (2) it does not hold for the solubility of many organic ammonium compounds in water and in chloroform, (3) it is unsatisfactory for the solubility of eight alkali chlorides in methyl, ethyl, propyl, and isoamyl alcohols, and

<sup>23</sup> E. H. McArdle, J. C. Moore, H. D. Terrell, E. C. Haines *et al.*, *Ind. Eng. Chem., Anal. Ed.*, **11**, 248 (1939).

<sup>24</sup> E. H. McArdle and E. L. Baldeschwieler, *Ind. Eng. Chem., Anal. Ed.*, **13**, 301 (1941).

<sup>25</sup> E. H. McArdle and E. L. Baldeschwieler, *Ind. Eng. Chem., Anal. Ed.*, **13**, 301 (1941).

<sup>26</sup> E. L. Baldeschwieler, M. D. Morgan, and W. J. Troller, *Ind. Eng. Chem., Anal. Ed.*, **7**, 374 (1935); **9**, 540 (1937).

<sup>27</sup> T. Graham, *J. Chem. Soc.* **17**, 318 (1864).

<sup>28</sup> P. Dutoit and E. Aston, *Compt. rend.* **125**, 240 (1897).

<sup>29</sup> P. Walden, *Z. physik. Chem.* **54**, 129 (1906).

<sup>30</sup> Sachanoff, *J. Russ. Phys. Chem. Soc.* **43**, 526 (1911).

<sup>31</sup> V. A. Plotnikoff, *J. Chem. Soc.* **114**, II, 183 (1918).

<sup>32</sup> P. Walden, *Z. physik. Chem.* **55**, 683 (1906).

<sup>33</sup> P. Walden, *Z. physik. Chem.* **61**, 633 (1908).

<sup>34</sup> W. E. S. Turner and C. C. Bassett, *J. Chem. Soc.* **105**, 947 (1914).

(4) that it does not even hold for tetrapropylammonium iodide by Walden's own results. An attempt made to find another equation was not successful, indicating that no general formula could be developed. They conclude that there is no parallelism between solvent action and dielectric constant. Generally, the dielectric constant of the solvent seems to have an influence only when the solute is an electrolyte, however, even under those conditions it is not the dominant factor in producing solution.

**Compressibility.**—Ritzer<sup>35</sup> investigated the compressibility of twelve organic liquid mixtures at various temperatures and found that the solvent power of the mixtures are always parallel to their compressibility or that these two properties are "sympat" using the term coined by Luther.<sup>36</sup> However, solvent power and surface tension are "antipat" when the solvent power shows a maximum. He deduced the principle that solubility is greater, the greater the solubility pressure, the greater the compressibility, and the smaller the volume change when solution takes place. Expressed mathematically

$$\lambda = \frac{P\beta}{\delta}$$

in which  $\lambda$  represents solubility,  $\beta$  represents compressibility,  $P$  represents solubility pressure, and  $\delta$  the dilution absorption coefficient. Values of  $\lambda$  calculated from this equation agree with experimentally determined values. This equation agrees also with the principle that the ratio of solubility of any two gases is independent of the solvent.

From a consideration of the studies of Lees<sup>37</sup> who found that in the case of mixtures of nonassociated liquids the viscosity cannot be calculated by any simple law and the studies of Dunstan<sup>38</sup> who found that there are relationships between curves obtained on

plotting viscosity against properties of the components, that abnormal curves were produced when reactions take place after the liquids are mixed, and that in some cases maxima were due apparently to dissociation. Baker<sup>39</sup> concluded that viscosity determinations of mixtures of alcohol and ether would probably give a clue to the reason for the solvent properties of such mixtures. From his data obtained with mixtures of methyl alcohol + ether, ethyl alcohol + ether, propyl alcohol + ether, methyl alcohol + anisole, ethyl alcohol + anisole, methyl alcohol + phenetole, and ethyl alcohol + phenetole and from the viscosity curves found for these mixtures, he concluded that dissociation of the alcohols takes place in these mixtures, that this dissociation is probably associated with the formation of an ether-alcohol complex, and that the solvent power of these mixtures for nitrocellulose is due to these complex compounds.

**Evaporation.**—In order to determine the change in solvency during the evaporation of thinners McArdle<sup>40</sup> allowed 100 ml. of a thinner (such as "mineral spirits" or a mixture of thinners of a similar boiling range) to evaporate in a special apparatus in the form of a film in less than three hours at room temperature. Aniline points were then determined on definite fractions of the residual thinner while the evaporation was taking place. This method is limited to determinations of changes in the solvency during evaporation at a speed similar to that in the setting of enamels and oleoresinous varnishes.

The various methods which have been suggested for the evaluation of solvent power (with particular emphasis on the use of petroleum solvents for paints) were reviewed by Kurtz,<sup>41</sup> who found that viscosity of resin solution is the best criterion of solvent power.

<sup>35</sup> A. Ritzer, *Z. physik. Chem.* **60**, 319 (1907).

<sup>36</sup> R. Luther, *Z. Elektrochem.* **12**, 97 (1906).

<sup>37</sup> C. H. Lees, *Phil. Mag.* [6] **1**, 128 (1901).

<sup>38</sup> A. E. Dunstan, *J. Chem. Soc.* **85**, 817 (1904); **91**, 83 (1907); **95**, 1556 (1909).

<sup>39</sup> F. Baker, *J. Chem. Soc.* **101**, 1409 (1912).

<sup>40</sup> E. H. McArdle, *Ind. Eng. Chem., Anal. Ed.* **11**, 450 (1939).

<sup>41</sup> S. S. Kurtz, Jr., *Natl. Petroleum News* **32**, No. 30, R-270 (1940).

**Viscosity.**—Relationships between the solvent power of organic liquids and the viscosity of cellulose ester solutions were studied by Sakaruda and Shojino.<sup>42</sup> They compared the shapes and solubility curves of a cellulose ester in a series of liquid mixtures where the latter consist of a nonpolar liquid (e.g., benzene) and an indifferent solvent; they determined also the solvent power of eleven organic solvents for two types of nitrocelluloses having different nitrogen contents.

These four new methods of determining solvent power are described by McBain, Grant, and Smith<sup>43</sup> who studied the viscosity of nitrocotton in various solvents and mixtures:

- (1) adding a diluent until nitrocotton is gelatinized,
- (2) pouring dilute hexane solutions of the solvent on nitrocotton and noting the swelling,
- (3) measuring sorption of solvents from dilute solutions in hexane by noting the refractive index of the supernatant liquid by a differential method, and
- (4) adding one gram of nitrocotton to 15 grams of the solvent and noting the rise in temperature.

**Viscosity Reduction.**—A viscosity reduction method for the commercial evaluation of hydrocarbon solvents for synthetic varnish resin of the Los Angeles Paint & Varnish Production Club is described by Huff<sup>44</sup> *et al.* From the results of tests on phenolic and modified phenolic resinous products the following conclusions are drawn: (1) solvent strength of hydrocarbon thinners can be reliably measured by determining the effect of

solvents on a composition of a type similar to that which it is intended that the solvent is to dissolve in actual practice, (2) solvent strength of any given solvents or combinations is a function of an area bounded by a graph of viscosity vs. nonvolatile by a volume relative to a selected base line, (3) viscosity characteristics of semicolloidal solutions (or dispersions) are a function of relative volumes of various components not of relative weights, (4) viscosity measurements of varnish oils and resin base solutions are a direct logarithmic function of the volume of nonvolatile portion within the viscosity ranges at which these materials are customarily used, and for purposes of solvent strength calculations should be plotted on semilogarithmic paper. A complete correlation between the viscosity-reducing character of solvents and "aniline point" does not seem to be indicated, at least insofar as the solvents are used as varnish thinners.

**Kauri-Butanol Test.**—The expression *solvent power* was defined by Kiehl<sup>45</sup> as the amount of a solvent which can be added to a standard kauri gum solution in butanol to produce a definite turbidity, as compared with the amount of pure benzene used in a similar titration and arbitrarily taken as 100 per cent standard.

Baldeschiwieler, Troeller, and Morgan<sup>46</sup> used the kauri-butanol test to determine the solvent power of a number of hydrocarbons and to correlate the results with the structure of these hydrocarbons. Some of their results are tabulated. It is seen that the solvent powers of paraffin hydrocarbons decrease definitely with increasing number of carbon atoms. Plotting the solvent power results against the number of carbon atoms yields an average straight line. Using the equation of this line

$$y + 0.6x = 22$$

<sup>42</sup> I. Sakaruda and M. Shojino, *Kolloid-Z.* **68**, 300 (1934); *J. Soc. Chem. Ind., Japan* **37**, Suppl. Binding, 603 (1934).

<sup>43</sup> J. W. McBain, E. M. Grant, and L. E. Smith, *J. Phys. Chem.* **38**, 1217 (1934).

<sup>44</sup> R. H. Huff *et al.*, *Am. Paint J.* **24**, Convention Daily, **12**, Nov. 1, 1939; *Paint Oil Chem. Rev.* **101**, No. 23, 90, 96 (1939).

<sup>45</sup> J. R. Kiehl, *Am. Paint Varnish Mfrs. Assoc., Circ.* **319**, 586 (1927).

<sup>46</sup> E. L. Baldeschiwieler, W. J. Troeller, and M. D. Morgan, *Ind. Eng. Chem., Anal. Ed.* **7**, 374 (1935); **9**, 540 (1937).

in which  $x$  represents the number of carbon atoms and  $y$  represents the solvent power by weight, it is possible to calculate the solvent power of any paraffin hydrocarbon. The results for the solvent power of the olefins show that introducing a double bond increases the solvent power of saturated hydrocarbons, and that the effect of the double bond increases with increasing molecular weight. The solvent power of the naphthenic hydrocarbons of the cyclohexane series decrease with increasing length of the paraffinic sidechain. The solvent power of any hydrocarbon in the cyclohexane series is given by the equation

$$S = 42.1 \left( \frac{6}{P+6} \right) + y \left( \frac{P}{P+6} \right)$$

In this equation  $S$  represents the solvent power by weight, 42.1 is the solvent power of cyclohexane,  $P$  represents the number of paraffinic carbon atoms, 6 is the number of naphthenic carbon atoms, and  $y$  represents the solvent power of the paraffin having  $P$  carbon atoms. Similarly, the solvent power of any hydrocarbon in the aromatic hydrocarbon series can be calculated by introducing in the foregoing equation the value 87.8, the

TABLE 4. SOLVENT POWER OF PARAFFIN HYDROCARBONS<sup>a</sup>

Hydrocarbon	Formula	Number of Carbon Atoms	Solvent Power
<i>n</i> -Pentane	C <sub>5</sub> H <sub>12</sub>	5	33.8
Isopentane	C <sub>5</sub> H <sub>12</sub>	5	28.8
<i>n</i> -Hexane	C <sub>6</sub> H <sub>14</sub>	6	26.5
2-Methylpentane	C <sub>6</sub> H <sub>14</sub>	6	25.0
<i>n</i> -Heptane	C <sub>7</sub> H <sub>16</sub>	7	25.4
<i>n</i> -Octane	C <sub>8</sub> H <sub>18</sub>	8	24.5
Iso-octane	C <sub>8</sub> H <sub>18</sub>	8	24.3
Trimethylpentane	C <sub>8</sub> H <sub>18</sub>	8	24.7
Diisoamyl	C <sub>10</sub> H <sub>22</sub>	10	24.5
Dodecane	C <sub>12</sub> H <sub>26</sub>	12	18.7
<i>n</i> -Tetradecane	C <sub>14</sub> H <sub>30</sub>	14	18.6
<i>n</i> -Hexadecane	C <sub>16</sub> H <sub>34</sub>	16	14.3

<sup>a</sup> From E. L. Baldeschwieler, M. D. Morgan, and W. J. Troeller, *Ind. Eng. Chem., Anal. Ed.* 9, 540 (1937).

TABLE 5. SOLVENT POWER OF OLEFIN HYDROCARBONS<sup>a</sup>

Hydrocarbon	Formula	Number of Carbon Atoms	Solvent Power
Hexene	C <sub>6</sub> H <sub>12</sub>	6	33.6
Octylene	C <sub>8</sub> H <sub>16</sub>	8	36.5
Diisobutylene	C <sub>8</sub> H <sub>16</sub>	8	35.2
Diisoamylene	C <sub>10</sub> H <sub>20</sub>	10	35.8
Triisobutylene	C <sub>12</sub> H <sub>24</sub>	12	32.3

<sup>a</sup> From E. L. Baldeschwieler, M. D. Morgan, and W. J. Troeller, *Ind. Eng. Chem., Anal. Ed.* 9, 540 (1937).

TABLE 6. SOLVENT POWER OF SOME AROMATIC HYDROCARBONS<sup>a</sup>

Compound	Formula	No. of Carbon Atoms	Solvent Power
Benzene	C <sub>6</sub> H <sub>6</sub>	6	100.0
Toluene	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	7	93.7
<i>o</i> -Xylene	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>	8	99.0
<i>m</i> -Xylene	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>	8	89.6
<i>p</i> -Xylene	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>	8	82.5
Ethylbenzene	C <sub>6</sub> H <sub>5</sub> C <sub>2</sub> H <sub>5</sub>	8	85.7
Cumene	C <sub>6</sub> H <sub>5</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	9	75.7
Mesitylene	1,3,5-C <sub>6</sub> H <sub>3</sub> (CH <sub>3</sub> ) <sub>3</sub>	9	85.9
Pseudocumene	1,3,4-C <sub>6</sub> H <sub>3</sub> (CH <sub>3</sub> ) <sub>3</sub>	9	105.5
<i>n</i> -Butylbenzene	C <sub>6</sub> H <sub>5</sub> C <sub>4</sub> H <sub>9</sub>	10	68.7
<i>tert</i> -Butylbenzene	C <sub>6</sub> H <sub>5</sub> C <sub>4</sub> H <sub>9</sub>	10	71.7
Methylisopropylbenzene	C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub> C <sub>3</sub> H <sub>7</sub>	10	68.3
<i>tert</i> -Amylbenzene	C <sub>6</sub> H <sub>5</sub> C <sub>5</sub> H <sub>11</sub>	11	66.0
Octadecylbenzene	C <sub>6</sub> H <sub>5</sub> C <sub>18</sub> H <sub>37</sub>	24	37.0

<sup>a</sup> From E. L. Baldeschwieler, M. D. Morgan, and W. J. Troeller, *Ind. Eng. Chem., Anal. Ed.* 9, 540 (1937).

solvent power of benzene, in place of 42.1, the solvent power of cyclohexane. The results obtained with naphthene and benzene hydrocarbons indicate that, generally, the solvent power of the compounds is affected not by the number of positions replaced in the ring but by the total length of the paraffinic chains. It is concluded that "given the solvent power of the first member of a hydrocarbon series, it is possible to calculate or at least obtain a fair idea of the solvent

TABLE 7. SOLVENT POWER OF SOME NAPHTHENIC HYDROCARBONS<sup>a</sup>

Compounds	Formula	No. of Carbon Atoms	Solvent Power
Cyclohexane	$C_6H_{12}$	6	54.3
Methylcyclohexane	$C_6H_{11}CH_3$	7	50.5
Methylisopropylcyclohexane	$C_6H_4CH_3C_3H_7$	10	39.3
Octadecylcyclohexane	$C_6H_{11}C_{18}H_{37}$	24	24.2
Heptadecyl- <i>n</i> -butylcyclohexylmethane	$C_6H_{11}CHC_4H_9C_{17}H_{35}$	28	19.8

<sup>a</sup> From E. L. Baldeschwieler, M. D. Morgan, and W. J. Troeller. *Ind. Eng. Chem., Anal. Ed.* **9**, 540 (1937).

power of other hydrocarbons of the same series. Conversely, the solvent power of an unknown hydrocarbon should give a clue to its composition and structure, thus providing an additional constant."

According to Stewart<sup>47</sup> the solvent power of a petroleum thinner is determined as follows:

**Procedure.**—1. Weigh kauri-butanol solution (usually 20.000 grams) accurately to the third (or the second decimal, if satisfactory) into a stoppered Erlenmeyer flask, such as an iodine flask, taking due care to prevent evaporation of the butyl alcohol from the solution which would change the strength of the standardized solution.

2. Add the petroleum thinner from a burette, keeping the temperature at  $25 \pm 0.2^\circ$  C. Add the first 30 ml. rapidly and then add drop by drop while keeping the flask in a swirling motion to prevent local precipitation or cloudiness.

3. When the first stage of clouding starts, place underneath the flask a sheet of white paper imprinted with 10 point Century type, light face, upper and lower

<sup>47</sup> J. R. Stewart, *Products Finishing* **9**, No. 1, 46 (1944).

case, and continue to titrate until the mixture has become so cloudy as to make the print illegible.

4. Record the number of milliliters required to reach this end point in the titration as the kauri-butanol value. Duplicate tests should be accurate within  $\pm 0.1$  ml.

The following kauri-butanol values are cited to give a relative idea of the values obtained with various thinners and solvents.

TABLE 8. AVERAGE KAURI-BUTANOL VALUE

<i>Liquid</i>	
Turpentine.....	61
Toluene.....	105
Mineral Spirits.....	35
Solvent Naphtha.....	85
Benzine.....	32
Solvesso No. 2.....	86
Lacquer Diluent.....	39
V. M. & P. Naphtha.....	37
Dipentene.....	105

**Aniline Point Test.**—Chavanne and Simon<sup>48</sup> were the first ones to suggest the use of critical solution conditions for the estimation of the aromatic content of hydrocarbon mixtures. Then Tizard and Marshall<sup>49</sup> suggested the use of a fixed volume of aniline for each test (50 per cent by volume). The use of a mixed aniline point test was then introduced in the United States for testing high aromatic solvents. As stated by Sweeney and McArdle:<sup>50</sup> "Mixed aniline point, which replaces straight aniline point as a solvency test for highly aromatic naphthas because of the comparatively high freezing point of aniline, requires no temperature control and provides an excellent measure of aromaticity for naphthas of similar boiling ranges." Details of the determination of mixed aniline points of hydrocarbon solvents are given by Shoemaker and Bolt.<sup>51</sup> The

<sup>48</sup> G. Chavanne and L. J. Simon, *Compt. rend.* **168**, 111 (1919).

<sup>49</sup> H. T. Tizard and A. G. Marshall, *J. Soc. Chem. Ind.* **40**, 20T (1920).

<sup>50</sup> W. J. Sweeney and E. H. McArdle, *Ind. Eng. Chem.* **33**, 787 (1941).

<sup>51</sup> B. H. Shoemaker and J. A. Bolt, *Ind. Eng. Chem., Anal. Ed.* **14**, 200 (1942).

standardization of mixed aniline points and a critical evaluation of aniline point determinations are presented by Gillam.<sup>52</sup>

Methods for the determination of aniline point and mixed aniline point have been standardized by the A. S. T. M. as for instance in their Designation D 1012-49T.

**Resin Solvency.**—As there is no definite relation between the kauri-butanol solvency of petroleum spirits and the viscosity of cold-cut solutions of resins dispersed in these spirits Kurtz, Harvey, and Lipkin<sup>53</sup> studied the concentration-viscosity relation for various resins dissolved in spirits or cuts lying within the boiling range of 300 to 400° F. Defining resin solvency as 100 times the kinematic viscosity of solution of  $\times$  % resin in standard spirit over the kinematic viscosity of solution of  $\times$  % resin in spirits under tests, they found that this resin solvency is approximately independent of the temperature of test and of the concentration. The relative solvent powers depend on the type of resin with which the solvency is determined and the logarithm of the kinematic viscosity is proportional to the concentration expressed as gram of resin per gram mole of solvent. The resin solvency of petroleum spirits for phenolic resins (Beckacite 1001) and ester gum resins (e.g., #6, American Cyanamid Co.) can be determined from the A.S.T.M. 50% boiling point, the density 20/4, and the refractive index  $n_{D}^{20}$ , by means of graphs determined by them. The graphs give results which agree with the experimental resin solvency within  $\pm 5$  units with natural spirits but do not apply to synthetic blends of pure compounds.

The heptane number method was designed for determining the relative solvent power of high-solvency hydrocarbon solvents in the presence of certain resins. The details are given in A.S.T.M. Designation D 1132-50T.

<sup>52</sup> N. W. Gillam, *Australian Chem. Inst. J. & Proc.* **9**, 77 (1942).

<sup>53</sup> S. S. Kurtz, Jr., W. T. Harvey, and M. R. Lipkin, *Ind. Eng. Chem., Anal. Ed.* **11**, 476, 484 (1939).

**Mix-Solvency.**—The term *mix-solvency* was proposed by Palit<sup>54</sup> to represent the increased solubility found in some mixture of solvents having low individual solvent power. Thus soaps exhibit very distinct mix solvency in the case of solvent mixtures consisting of a polyhydric alcohol, a monohydric alcohol, and (or) a hydrocarbon or chlorinated hydrocarbon. In order for a single solvent or a mixture to be a good soap solvent it must have two adjacent hydroxyl groups and a hydrocarbon dissolving constituent. Thus in mixtures of alcohols, glycols, and hydrocarbons the combinations alcohol-glycol, glycol-alcohol, and alcohol-glycol-hydrocarbon will be active solvents; however, alcohol-hydrocarbon mixtures are poor soap solvents. He proposed an explanation of mix solvency based on the solvation of different parts of the solute molecule by 'van der Waals' forces and H-bridge formation. In later studies Palit<sup>55</sup> investigated the relationship between solvent power, gelation capacity, and viscosity of shellac solution in mixed solvents as well as the solvent-solute relationship of resins in mixed solvents.

**Velocity of Solution.**—Bare and Nelson<sup>56</sup> measured solvent power by determining the velocity of solution using a cylindrical brass instrument, 2.5 in. long, 1.5 in. in diameter, and having a 0.25-in. bore through the main axis and a recess 0.25 in. deep in one head so as to leave a circular wall 0.018 in. thick. Two felt disks, 0.25 in. thick, are compressed into the recessed head, and the apparatus is placed on a nitrocellulose film 0.005 in. thick, attached to a wooden frame. The sample of solvent is pipetted into the axial bore, and the time is measured between the appearance of saturation at the edge of the felt and the falling or toppling of the

<sup>54</sup> S. R. Palit, *J. Indian Chem. Soc.* **19**, 27 (1942).

<sup>55</sup> S. R. Palit, *J. Indian Chem. Soc.* **19**, 207, 25 (1942).

<sup>56</sup> B. M. Bare, Jr., and H. H. Nelson, *Pain Oil & Chem. Rev.* **101**, No. 5, 7 (1939).

weight through the film. This time is longer the poorer the power of the solvent to dissolve the nitrocellulose. The ability of a solvent to tolerate dilutions of its solutions with nitrocellulose with nonsolvents is not parallel with the speed of dissolving the nitrocellu-

lose. They observed increasing speed of solution in the following order: isobutyl propionate, butyl acetate, *sec*-butyl acetate, Cellosolve, isopropyl acetate, ethyl acetate, and the group dimethyl ketone, ethyl methyl ketone, and isobutyl methyl ketone.

# Chapter IV

## VAPOR PRESSURE

All liquids or solids have the tendency to vaporize at all temperatures; this tendency which varies with the temperature and external pressure is called vapor pressure and is measured in standard pressure units such as millimeters of mercury, atmospheres, etc. Enclosing a solvent in a given space at a definite temperature will allow vaporization to take place only until the partial pressure of the vapor above the liquid has reached its vapor pressure at that temperature. Further evaporation can be induced at the same temperature by removing some of the vapor which in turn lowers the vapor pressure over the liquid.

**Clausius-Clapeyron Equation.**—A relationship between vapor pressure of a substance and its heat of vaporization is given by the Clausius-Clapeyron equation

$$\frac{d \log_e P}{dT} = \frac{\lambda}{RT^2}$$

In this equation  $\log_e P$  represents the natural logarithm of the pressure,  $T$  represents the absolute temperature,  $\lambda$  represents the mean potential energy difference per mol, and  $R$  is the gas constant 1.99. This equation is based on the assumption that the simple gas laws apply to saturated vapors and also on the assumption that the specific volume of the substance in the liquid state can be neglected when compared to the specific volume of the vapors. It is applicable for short temperature ranges.

**Trouton's Rule.**—A relationship between the heat of vaporization and the absolute

boiling point of a liquid is given by Trouton's rule

$$\frac{ML_v}{T} \approx 21$$

which is used to calculate approximately the vapor pressure curve of a substance of unknown latent heat of vaporization. In this equation  $T$  represents the absolute boiling point and  $L_v$  represents the heat of evaporation of one gram of liquid of molecular weight  $M$ ; it implies that the ratio of molecular heat of vaporization of a liquid to its absolute boiling temperature is approximately 21. The following solvents give Trouton's constants close to this value:

Acetal.....	20.78
Acetonitrile.....	19.74
Aniline.....	21.22
	23.20
Benzene.....	20.87
Carbon disulfide.....	20.4
Chloroform.....	20.84
Diethylacetone.....	20.90
Dipropylacetone.....	20.73
Ethyl ether.....	21.1
Ethyl propionate.....	22.45
Methylethylacetone.....	21.25
Methyl formate.....	21.69
Methyl salicylate.....	22.2
Nitrobenzene.....	20.70
Octane.....	20.28
Propyl formate.....	22.45
Pyridine.....	20.12
Toluene.....	20.84
<i>o</i> -Toluidine.....	21.55

These solvents give Trouton's constants appreciably above 21:

Ethyl alcohol.....	26.39
	28.40
Isobutyl alcohol.....	26.12

Methyl alcohol.....	24.83
Propyl alcohol.....	26.59
Water.....	25.90

These solvents give Trouton's constants appreciably below 21:

Acetic acid.....	13.74
Formic Acid.....	14.83
Propionic acid.....	16.34

Deviations in the Trouton constant are probably due to polymerization reactions taking place in the liquid state.

As the Trouton constant varies with the temperature, modifications of the Trouton equation were proposed by Nernst and also by Bingham. Thus Bingham's modification of this equation

$$\frac{ML_v}{T} = 17 + 0.011T$$

holds for more substances than the original Trouton relationships; however, since in some cases the product of  $M$  and  $L_v$  divided by  $T$  exceeds the sum of  $17 + 0.01T$ , Bingham concluded that in these cases the molecular weight of the liquid exceeds that of its vapor.

**Raoult's Law.**—Relationships between the distribution of a substance between the two phases, liquid and vapor, are given by Raoult's law which in its simplest form is given by the equation

$$p = p_0x_0$$

in which  $p$  represents the vapor pressure of the liquid after the introduction of a solute,  $x_0$  represents the mol-fraction of the liquid existing as the molecular species which produces the vapor pressure, and  $p_0$  denotes the vapor pressure of the pure liquid. This law indicates that in the case of solutions the vapor pressure of a solution is proportional to the mol-fraction of the solvent in this solution. However, it does not indicate the vapor pressure of the solution in those cases where the molecules of the vaporized solvent are dissociated. Although the vapor pressure of a volatile liquid is lowered by the addition of a solute and although this

lowering of the vapor pressure is approximately proportional to the concentration of the solute in the solution, it should be noted that (1) ionizing solutes in aqueous solutions bring about a greater decrease of vapor pressure than correspond to their molecular weight, and (2) solutions in organic solvents tend to undergo association rather than dissociation reactions, and the lowering of the vapor pressure of such organic solutions is usually smaller than the calculated figure.

**Henry's Law.**—Relationships between the vapor pressure of a volatile substance dissolved in a solvent and the amount of substance present are given by Henry's law which is based on the same principle as Raoult's law. According to this law the vapor pressure of a solute in solution is proportional to its mol-fraction, i.e.,

$$p = kx$$

In this equation  $p$  represents the partial pressure of the volatile substance over the solution,  $k$  denotes a proportionality constant, and  $x$  is the mol fraction of the volatile substance. It does not hold accurately for very dilute solutions in which solute and solvent react with another chemically.

Since the vapor pressure of a substance indicates its concentration in the vapor state, it is possible to restate Henry's law in a different form for the case of dilute solutions of gases in liquids as follows:

$$\frac{c}{p} = k$$

In this relationship  $c$  denotes the concentration of the solute for very dilute solutions and  $p$  indicates the vapor pressure corresponding to this concentration. When stated in this form Henry's law indicates that the distribution of a gas between the two phases, liquid and gas, is constant. The law can be stated also in various other ways as follows: When a gas is absorbed by a liquid solvent, the weight of the gas in solution is proportional to the pressure of the gas. Further-

more, taking into consideration *Boyle's law* (at constant pressure the volume of a gas is inversely proportional to the pressure) Raoult's law can be stated as follows: The volume of a gas absorbed by a definite volume of a liquid solvent is independent of the pressure. The most general expression for Henry's law is

$$\frac{c_1}{c_2} = k$$

In this equation  $c_1$  indicates the concentration of the gas in the gaseous phase which is proportional to the pressure,  $c_2$  represents the concentration in the liquid phase, and  $k$  denotes a constant. In this form Henry's law states that at constant temperature the concentrations of any single molecular species in two phases at equilibrium bear a constant ratio to each other.

If the solute is a volatile liquid, then the effects of the two vapor pressures one upon another depend on whether the two liquids are completely miscible, partly miscible, or completely immiscible in another. If the two liquids are completely miscible, they lower each other's vapor pressures; if they are nearly completely immiscible, the vapor pressure of the mixture is the sum of the partial pressure of each liquid layer; if both liquids are partially miscible, the relationships are more complex.

An experimental study of the vapor pressures of binary mixtures was made by Marshall;<sup>1</sup> nitroglycerine + acetone, diethylamine + acetone, alcohol + ethyl methyl ketone, water + ethyl methyl ketone, water + methyl acetate, water + ether, and water + alcohol. He divides the curves showing the change of partial pressure with molecular composition into four types. Three types relate to compounds which are miscible in all proportions and are distinguished from each other depending on whether  $p/x$  (the partial pressure divided by the molecular proportion) is less than, equal to, or greater

than the vapor pressure of the pure compound. By adding the two partial pressures which are of the same type the corresponding total pressure curve is obtained. These total pressure curves can be divided into twelve types by differentiating the equation

$$x d \log p_1 + (1 - x) d \log p_2 = 0$$

In this equation  $p_1$  and  $p_2$  represent the partial pressures exerted by two substances 1 and 2,  $x$  represents the molecular proportion of substance 1 in the liquid mixture (= the number of gram molecules of substance 1 / (number of gram molecules of substance 1 + number of gram molecules of substance 2)), while  $1 - x$  represents the molecular proportion of substance 2. This equation which deals with changes in pressure at constant temperature was developed independently by several investigators and its accuracy was confirmed experimentally by von Zawidski.<sup>2</sup> With substances miscible in all proportions there is only one maximum or minimum in the total pressure curve. Regnault's law (a rule stated thus by Duhem: For partially miscible liquids the total pressure of the heterogeneous mixture is equal to the vapor pressure of the more volatile components in the pure state) was shown by Marshall to be approximately true for methyl acetate and water and also for ether and water and to be only an approximation which holds only in some cases.

The effect on the vapor pressure of the addition of a third component to a binary mixture was studied by Schreinemakers<sup>3</sup> who developed a very complicated formula to cover such cases. The tertiary mixture may have a higher or lower boiling point than the binary mixture to which the third component was added.

Differences between the vapor pressure of solutions and that of the solvent were measured by a static method by Frazer and Love-

<sup>2</sup> J. von Zawidski, *Z. physik. Chem.* **35**, 129 (1900).

<sup>3</sup> F. A. H. Schreinemakers, *Z. physik. Chem.* **48**, 257 (1904).

<sup>1</sup> A. Marshall, *J. Chem. Soc.* **89**, 1350 (1906).

lace.<sup>4</sup> A Raleigh manometer was used which is sensitive to pressure differences as slight as 0.00058 mm. Hg. In place of stopcocks traps of mercury were employed and exceedingly careful precautions were taken to remove all traces of dissolved gases; the latter was checked by means of a McLeod gauge or else by the velocity of the establishment of the equilibrium. Tests were made on the lowering of the vapor pressure produced in solutions of mannitol in water. 0.5 and 0.4 molar mannitol solutions were tested giving vapor pressure depressions of 0.156 and 0.122 mm. Hg respectively. Following the first eight days when air was removed from the solutions, the maximum pressure variations found over a period of two months was approximately 0.0005 mm. Hg, or 0.4%.

#### EVAPORATION AND EVAPORATION RATES

The rate of evaporation is one of the most important properties to be considered in the selection of a solvent. Thus when used in a lacquer, a slowly evaporating solvent delays hardening and setting up, whereas a solvent with an excessively high rate of evaporation may cause orange peel, blushing, bad flow, etc. The rates of evaporation of organic solvents and thinners have been determined by various investigators on a number of occasions using a variety of different methods. Data on evaporation rates cannot be stated in absolute figures because these rates are affected by a great variety of influences, many of which cannot be evaluated properly. Some of the factors which affect evaporation rates and consequently drying times are the temperature of the fluid, temperature of the atmosphere above the liquid, rapidity of the escape of solvent vapor from the surface of the fluid, heat conductivity, molecular association, molecular weight, vapor pressure, surface tension, humidity, latent heat of evaporation, vapor density, solvent power, etc. While the literature contains

various tables on the rates of evaporation of a number of solvents, it is evident from the many factors just listed which influence this property that the correct determination of this rate is difficult. Many published figures, therefore, are not very accurate, and care should be taken in accepting and comparing data from different sources.

Because of the importance of evaporation rates, particularly in the protective coating industry, a great variety of different methods have been suggested and developed for measuring this complex factor quantitatively. The determination of the rate of evaporation, as stated by Lowell,<sup>5</sup> "if carried out on a comparative basis, furnishes a measure of the relative drying times of lacquers, and as a consequence yields valuable preliminary information pertaining to the probable flowing-out characteristics and blush-resistance of the drying film." Thus typical methods and devices for measuring and comparing the evaporation rates of solvents have been described by Polcich and Fritz,<sup>6</sup> Bridgman,<sup>7</sup> Wilson and Worster,<sup>8</sup> Hart,<sup>9</sup> Hofmann,<sup>10</sup> Gardner,<sup>11</sup> Rubek and Dahl,<sup>12</sup> Lowell, Wetlaufer and Gregor,<sup>13</sup> Bent and Wik,<sup>14</sup> and others.<sup>14a</sup>

The more reliable relative rates of evaporation of common commercial lacquer sol-

<sup>5</sup> J. H. Lowell, *Ind. Eng. Chem., Anal. Ed.* **7**, No. 4, 278 (1035).

<sup>6</sup> G. Polcich and H. Fritz, *Brennstoff Chem.* **5**, 371 (1924).

<sup>7</sup> J. A. Bridgman, *Ind. Eng. Chem.* **20**, 184 (1928).

<sup>8</sup> W. M. Wilson and F. J. Worster, *Ind. Eng. Chem.* **21**, 592 (1929).

<sup>9</sup> L. P. Hart, *Circ.* **360**, *Sci. Sect. Ed. Bur., Am. Paint Varnish Mfrs. Assoc.*, 1930.

<sup>10</sup> H. E. Hofmann, *Ind. Eng. Chem.* **24**, 135 (1932).

<sup>11</sup> G. A. Gardner, *Physical and Chemical Examination of Paints, Varnishes, Lacquers, and Colors*. Institute of Paint and Varnish Research, Washington, D.C., 1933.

<sup>12</sup> D. B. Rubek and G. W. Dahl, *Ind. Eng. Chem., Anal. Ed.* **6**, 421 (1934).

<sup>13</sup> L. A. Wetlaufer and J. B. Gregor, *Ind. Eng. Chem., Anal. Ed.* **7**, 290 (1935).

<sup>14</sup> F. A. Bent and S. N. Wik, *Ind. Eng. Chem.* **28**, 312 (1936).

<sup>14a</sup> R. J. Curtis, J. R. Scheibli, and T. F. Bradley, *Anal. Chem.* **22**, 538 (1950).

<sup>4</sup> J. C. W. Frazer and B. F. Lovelace, *J. Am. Chem. Soc.* **36**, 2349 (1914).

TABLE 9. SOME PHYSICAL CONSTANTS

Solvent *	Chemical Formula	Molecular Weight	Boiling Point of Pure Material	Evaporation Rate by Weight ( <i>n</i> -Butyl Acetate = 100)
(1) Methyl Acetate.....	$\text{CH}_3\text{CO}_2\text{CH}_3$ .....	74.08	59-60	1040
(2) Acetone.....	$\text{CH}_3\text{COCH}_3$ .....	58.08	56.1	720
(3) Ethyl Acetate.....	$\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5$ .....	88.10	77.1	525
(4) Methyl Ethyl Ketone....	$\text{CH}_3\text{COC}_2\text{H}_5$ .....	72.10	79.6	465
(5) Benzene.....	$\text{C}_6\text{H}_6$ .....	78.11	79.6	500
(6) Isopropyl Acetate.....	$\text{CH}_3\text{CO}_2\cdot\text{CH}(\text{CH}_3)_2$ .....	102.13	89.0	435
(7) Methanol.....	$\text{CH}_3\text{OH}$ .....	32.04	64.5	370
(8) Ethyl Propionate.....	$\text{C}_2\text{H}_5\text{CO}_2\text{C}_2\text{H}_5$ .....	102.13	99.1	300
(9) Isopropyl Alcohol.....	$(\text{CH}_3)_2\text{CHOH}$ .....	60.09	82.5	205
(10) Ethyl Alcohol.....	$\text{C}_2\text{H}_5\text{OH}$ .....	46.07	78.5	203
(11) Diethyl Ketone.....	$(\text{C}_2\text{H}_5)_2\text{CO}$ .....*	86.13	102-7	.....
(12) Toluol.....	$\text{C}_6\text{H}_5\text{CH}_3$ .....	92.13	111.0	195
(13) <i>sec</i> -Butyl Acetate.....	$\text{CH}_3\text{CO}_2\text{CH}(\text{CH}_3)\cdot\text{C}_2\text{H}_5$ .....	116.15	111.5	180
(14) Isobutyl Acetate.....	$\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$ .....	116.15	118.5	152
(15) Isobutyl Methyl Ketone (Hexone).....	$\text{CH}_3\text{COC}_4\text{H}_9$ .....	100.15	118.0	145
(16) <i>sec</i> -Butyl Alcohol.....	$\text{CH}_3\text{CHOHC}_2\text{H}_5$ .....	74.12	99.5	115
(17) <i>n</i> -Butyl Acetate.....	$\text{CH}_3\text{CO}_2\text{C}_4\text{H}_9$ .....	116.15	126.5	100
(18) Mesityl Oxide.....	$(\text{CH}_3)_2\text{C}\cdot\text{CH}\cdot\text{CO}\cdot\text{CH}_3$ .....	98.14	128.7	87
(19) <i>sec</i> -Amyl Acetate.....	$\text{CH}_3\text{CO}_2\text{C}_5\text{H}_{11}$ .....	130.18	130-8	87
(20) Isobutyl Alcohol.....	$(\text{CH}_3)_2\text{CH}\cdot\text{CH}_2\text{OH}$ .....	74.12	107-8	83
(21) Xylol.....	$\text{C}_6\text{H}_4(\text{CH}_3)_2$ .....	106.16	135-45	68
(22) Amyl Acetate (Fusel Oil).....	* $\text{CH}_3\text{CO}_2\text{C}_5\text{H}_{11}$ .....	130.18	130-50	.....
(23) Pentacetate.....	* $\text{CH}_3\text{CO}_2\text{C}_5\text{H}_{11}$ .....	130.18	130-45	63
(24) Methyl Cellosolve.....	$\text{CH}_3\text{OC}_2\text{H}_4\text{OH}$ .....	76.09	124.5	55
(25) Dipropyl Ketone.....	$(\text{C}_3\text{H}_7)_2\text{CO}$ .....	114.18	143.5	49
(26) <i>n</i> -Butyl Alcohol.....	$\text{C}_4\text{H}_9\text{CH}_2\cdot\text{CH}_2\text{OH}$ .....	74.12	117.1	45
(27) Methyl Cellosolve Acetate.....	$\text{CH}_3\text{CO}_2\text{C}_2\text{H}_4\text{OCH}_3$ .....	118.13	143.0	40
(28) Cellosolve.....	$\text{C}_2\text{H}_5\text{OC}_2\text{H}_4\text{OH}$ .....	90.12	135.0	40
(29) Methyl Diacetone Ether..	$(\text{CH}_3)_2\text{C}(\text{OCH}_3)\text{CH}_2\text{COCH}_3$ .....	130.16	157.0	35
(30) Pentasol.....	* $\text{C}_5\text{H}_{11}\text{OH}$ .....	88.14	120-30	30
(31) Methyl Lactate.....	$\text{CH}_3\cdot\text{CHOH}\cdot\text{CO}_2\text{CH}_3$ .....	104.10	144.8	29
(32) Cyclohexanone.....	$\text{CH}_2(\text{CH}_2)_4\cdot\text{CO}$ .....	98.14	155-7	25
(33) Cellosolve Acetate.....	$\text{CH}_3\text{CO}_2\text{C}_2\text{H}_4\text{OC}_2\text{H}_5$ .....	132.16	156.2	24
(34) Ethyl Lactate.....	$\text{CH}_3\cdot\text{CHOH}\cdot\text{CO}_2\text{C}_2\text{H}_5$ .....	118.13	155.0	22
(35) Diacetone Alcohol.....	$(\text{CH}_3)_2\text{COH}\cdot\text{CH}_2\text{COCH}_3$ .....	116.15	166.0	15
(36) Butyl Cellosolve.....	$\text{C}_4\text{H}_9\text{OC}_2\text{H}_4\text{OH}$ .....	118.17	170.6	10
(37) Cyclohexanol.....	$\text{CH}_2(\text{CH}_2)_4\text{CHOH}$ .....	100.15	160-1	9
(38) Butyl Lactate.....	$\text{CH}_3\text{CHOHCO}_2\text{C}_4\text{H}_9$ .....	146.18	188.0	6
(39) Carbitol.....	$\text{C}_2\text{H}_5\text{OC}_2\text{H}_4\text{OC}_2\text{H}_4\text{OH}$ .....	134.17	201.9	.....

\* From C. F. Bogin, in J. J. Mattiello, ed., *Protective and Decorative Coatings*, Chapter 27. Vol. I. Wiley, New York, 1947.

\* Mixture of Isomers.

vents as compiled by Bogin<sup>15</sup> are shown in Table 9 together with additional significant data. As clearly indicated by the data given and as already stated by Bogin, there is no

definite and simple relationship between rate of evaporation and boiling point. Thus ethyl alcohol (b.p. 78.5° C.) which boils less than 3 degrees below the boiling point of ethyl acetate (b.p. 88.1° C.) evaporates only 40% as fast as the latter; toluene and *sec*-butyl acetate which have practically the same boiling

<sup>15</sup> C. F. Bogin, in J. J. Mattiello, ed., *Protective and Decorative Coatings*, Chapter 27. Vol. I. Wiley, New York, 1947.

OF LACQUER SOLVENTS; COMMERCIAL QUALITY<sup>a</sup>

Vapor Pressure at 30° C.	Ratio of Product of Vapor Pressure × Molecular Weight to the Similar Value of Butyl Acetate	Heat of Vaporization in Calories per Gram at 30° C.	Solubility of Material in Water in ml. per 100 ml. of Water at 20° C.	Solubility of Water in Material in ml. per 100 ml. of Material at 20° C.	Specific Gravity at $\frac{20^{\circ}\text{C.}}{4}$	Pounds per Gallon at 20° C.
265	1062	105.0	About 35.0	About 9.0	0.935	7.8 (1)
280	875	130.0	Miscible	Miscible	0.792	6.6 (2)
120	570	97.0	About 9.0	About 3.0	0.886	7.37 (3)
119	462	112.0	32.	About 8.0	0.805	6.72 (4)
118	496	102.2	Immiscible	Immiscible	0.878	7.31 (5)
74	406	87.0	About 6.0	About 1.0	0.874	7.28 (6)
165	284	276.0	Miscible	Miscible	0.793	6.6 (7)
43	237	91.6	.....	.....	0.875	7.3 (8)
60	194	184.0	Miscible	Miscible	0.789	6.58 (9)
79	193	216.2	Miscible	Miscible	0.791	6.6 (10)
46	213	.....	.....	.....	0.815	6.78 (11)
36	178	98.0	Immiscible	Immiscible	0.866	7.22 (12)
29	181	.....	Not more than 1.0	.....	0.860	7.16 (13)
27	169	.....	.....	.....	0.860	7.16 (14)
25	134	93.2	2.4	2.3	0.802	6.67 (15)
26	104	.....	.....	.....	0.808	6.72 (16)
16	100	83.0	0.5	1.6	0.875	7.29 (17)
.....	.....	152.0	3.4	3.0	0.858	7.12 (18)
10	70	.....	Not more than 1.0	.....	0.862	7.18 (19)
18	68	147.0	.....	.....	0.803	6.68 (20)
11	63	.....	Immiscible	Immiscible	0.865	7.2 (21)
.....	.....	.....	Not more than 1.0	.....	0.865	7.2 (22)
9	63	.....	1.0	1.5	0.865	7.2 (23)
.....	.....	127.0	Miscible	Miscible	0.964	8.04 (24)
9	55.4	.....	.....	.....	0.820	6.84 (25)
10.5	44	161.0	10.7	20.5	0.810	6.75 (26)
6	38.2	91.5	Miscible	Miscible	1.004	8.37 (27)
7	34	124.0	Miscible	Miscible	0.931	7.75 (28)
.....	.....	.....	.....	.....	.....	.... (29)
.....	.....	.....	3.0	8.4	0.814	6.77 (30)
.....	.....	.....	Miscible	Miscible	1.090	9.09 (31)
7	37.2	.....	.....	.....	0.946	7.87 (32)
3.5	24.8	79.0	29.0	6.2	0.974	8.10 (33)
4.0	25.5	.....	Miscible	Miscible	1.030	8.60 (34)
2	12.4	55.0	Miscible	Miscible	0.936	7.79 (35)
2	12.9	96.5	Miscible	Miscible	0.902	7.50 (36)
2	10.7	.....	.....	.....	0.962	8.02 (37)
.....	.....	.....	3.5	14.5	0.980	8.16 (38)
.....	.....	100.0	Miscible	Miscible	0.990	8.25 (39)

NOTE: The values for the Commercial Ester Solvents will vary somewhat with their Ester Value, or Percentages of Alcohols in them. The values in this table are for the grades most commonly used by the Lacquer Industry.

ing point (111.0 and 111.5° C., respectively) differ in their evaporation rates by about 10%.  
The most important reasons given by Bogin for the disagreement between the indications of the boiling points and the actual evaporation rates are that (1) boiling points

are a measure of the relative vaporization tendencies of liquids at higher temperatures but give only an imperfect picture of relations between them at ordinary temperatures, and (2) vapor pressure, as has been mentioned, is only one of the fundamental factors which control the rate of evaporation;

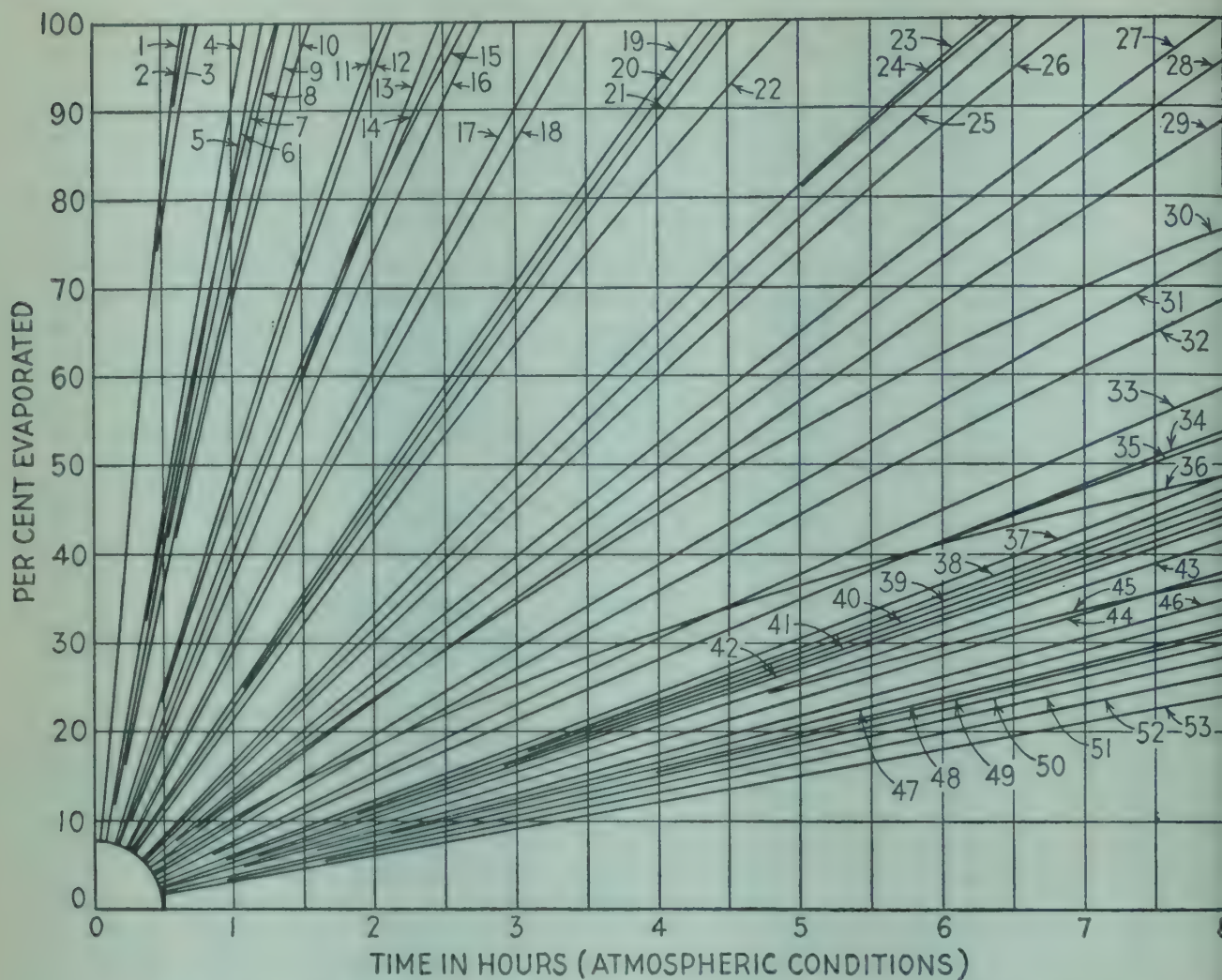


FIG. 3. Relative Evaporation Rates of Fast to Intermediate Evaporating Liquids

1. Methyl acetate.....	82%	17. Toluene.....	—	35. <i>n</i> -Butyl propionate.....	99%
2. Acetone.....	99	18. Solvesso No. 1.....	—	36. Hi-Flash naphtha.....	—
3. Methylacetone (acetone 48 per cent, methyl acetate 28 per cent, methanol 24 per cent).....	—	19. <i>sec</i> -Butyl acetate.....	82%	37. Methyl Cellosolve.....	99
4. Cyclohexane.....	—	20. Hexone (isobutyl methyl ketone).....	99	38. Dipropyl ketone.....	99
5. Benzene.....	—	21. Isobutyl acetate.....	96	39. Methyl amyl acetate.....	95
6. Ethylene dichloride.....	99	22. Ethyl butyrate.....	99	40. Steam-distilled turpentine..	—
7. Ethyl acetate.....	85	23. Diethyl Cellosolve.....	95	41. <i>n</i> -Butanol.....	99
8. Methanol (anhydrous).....	99	24. Diethyl carbonate.....	91	42. <i>sec</i> -Amyl alcohol.....	99
9. Ethyl methyl ketone.....	99	25. <i>sec</i> -Butanol.....	99	43. Gum spirits of turpentine..	—
10. Isopropyl acetate.....	95	26. Monochlorobenzene.....	—	44. <i>n</i> -Amyl methyl ketone.....	98
11. Ethyl propionate.....	96	27. <i>n</i> -Butyl acetate.....	90	45. Solvesso No. 2.....	—
12. Ethanol (anhydrous).....	99	28. Mesityl oxide.....	86	46. Amyl alcohol, mixed isomers	99
13. Methyl propyl ketone.....	99	29. <i>n</i> -Butyl methyl ketone.....	87	47. Methyl amyl alcohol.....	99
14. Isopropanol (anhydrous)...	99	30. Xylene.....	—	48. Cellosolve.....	99
15. Diethyl ketone.....	99	31. Isobutanol.....	99	49. Methyl Cellosolve acetate..	99
16. Petroleum naphtha.....	—	32. <i>sec</i> -Amyl acetate.....	92	50. Cyclohexanone.....	67
		33. <i>sec</i> -Hexyl acetate.....	98	51. Isopropyl Cellosolve.....	97
		34. Amyl acetate, mixed isomers	84	52. Hexyl (2-ethyl butyl) acetate	91
				53. Cellosolve acetate.....	96

another fundamental factor is the molecular weight.

**Calculation of Relative Rate.**—One method of calculating the relative rate of evaporation of solvents approximately is to multiply the molecular weight of the solvent by its vapor pressure at the temperature for which an estimation of the rate is desired. An inspection of the table shows that this approximation gives fairly accurate values in

most cases. There are some exceptions, however, e.g., methyl alcohol. Such disagreements are due in many cases to the presence of molecular aggregates of the liquid solvent under ordinary conditions.

**Evaporation Rates and Temperature.**—As already stated one of the important factors controlling the rate of evaporation of a solvent is temperature. An examination of vapor pressure data and of evaporation rate

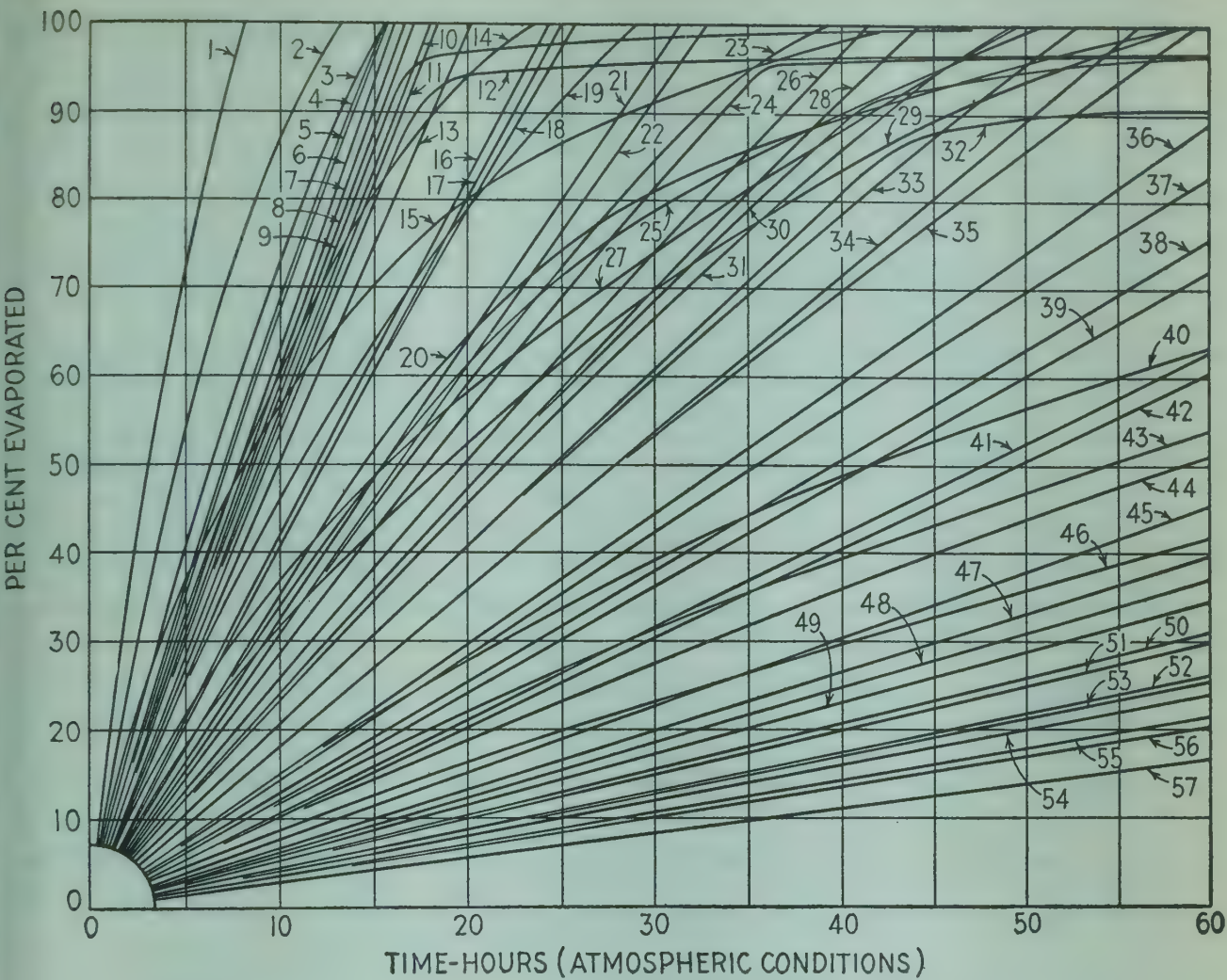


FIG. 4. Relative Evaporation Rates of Intermediate to Slow Evaporating Liquids

1. <i>n</i> -Butyl acetate.....	90%	19. Solvesso No. 2.....	—	39. Cyclohexanyl acetate.....	79%
2. Xylene.....	—	20. Cyclohexanone.....	67%	40. Hercosol.....	—
3. <i>sec</i> -Hexyl acetate.....	98	21. Isopropyl Cellosolve.....	97	41. Hexyl (2-ethyl butyl) alcohol	99
4. Amyl acetate (mixed iso- mers).....	84	22. Hexyl (2-ethyl butyl) acetate	91	42. Fenchone.....	—
5. <i>n</i> -Butyl propionate.....	99	23. Cellosolve acetate.....	96	43. Safe-T-Esso.....	—
6. Methyl Cellosolve.....	99	24. Ethyl lactate.....	98	44. Phorone.....	—
7. Dipropyl ketone.....	99	25. Methylcyclohexanone.....	74	45. Butyl Cellosolve.....	99
8. Methyl amyl acetate.....	95	26. Butyl butyrate.....	99	46. Solvesso No. 3.....	—
9. Steam-distilled turpentine..	—	27. V. M. & P. naphtha.....	—	47. Cyclohexanol.....	94
10. <i>n</i> -Butanol.....	99	28. Diisobutyl ketone.....	95	48. Furfuryl acetate.....	99
11. <i>sec</i> -Amyl alcohol.....	99	29. Mineral spirits.....	—	49. Acetonylacetone.....	95
12. Gum spirits of turpentine..	—	30. Isopropyl lactate.....	99	50. Tetrahydrofurfuryl alcohol.	99
13. <i>n</i> -Amyl methyl ketone.....	98	31. Furfural.....	98	51. Diethyl Carbitol.....	99
14. Amyl alcohol (mixed iso- mers).....	99	32. Dipentene.....	—	52. Furfuryl alcohol.....	98
15. Hi-Flash naphtha.....	—	33. <i>o</i> -Dichlorobenzene.....	—	53. Tetrahydronaphthalene.....	—
16. Methyl amyl alcohol.....	99	34. Diacetone alcohol.....	99	54. Octyl (2-ethyl hexyl) acetate	99
17. Cellosolve.....	99	35. 3-Methoxy butyl acetate....	99	55. Butyl Cellosolve acetate....	99
18. Methyl Cellosolve acetate..	99	36. <i>n</i> -Hexyl methyl ketone.....	96	56. Butyl lactate.....	97
		37. Dichloroethyl ether.....	99	57. Glycol diacetate.....	99
		38. Decahydronaphthalene.....	—		

made by Bogin<sup>15</sup> showed that the vapor pressure of liquids increases approximately 3% for every rise in temperature of 1° F. and that a rise in temperature of 20° F. may increase the evaporation rate of solvent mixture as much as 50%. As the average temperature of spray room in cold and hot seasons of the year may easily vary by as much as 20° F., the behavior of the same lac-

quer under different temperature conditions varies markedly. This points to the necessity of varying the solvent in a given lacquer composition in accordance with the temperature of the season.

**Relative Evaporation Rates.**—Curves of the relative evaporation rates of (1) fast to intermediate evaporating liquids, (2) intermediate to slow evaporating liquids, and

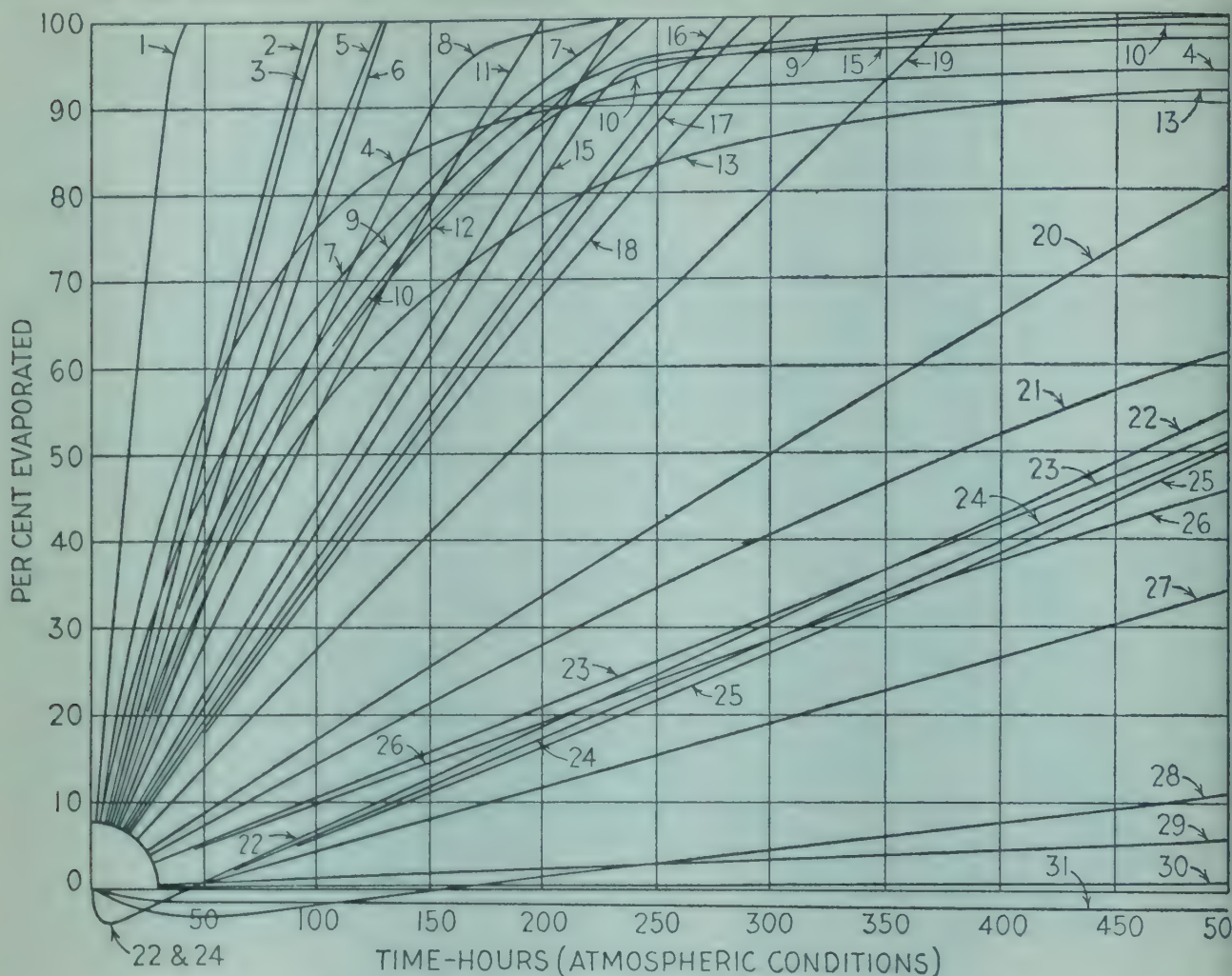


FIG. 5. Relative Evaporation Rates of Slow to Very Slow Evaporating Liquids

1. Cellosolve acetate.....	96%	12. Solvesso No. 3.....	—	23. Methyl Carbitol acetate....	99%
2. Hexyl (2-ethyl butyl) acetate	99	13. Furfuryl alcohol.....	98%	24. Carbitol.....	—
3. Fenchone.....	—	14. Diethyl Carbitol.....	99	25. Benzyl alcohol.....	99
4. Hercosol.....	—	15. Tetrahydronaphthalene.....	—	26. Heavy pine oil.....	—
5. Phorone.....	—	16. Octyl (2-ethyl hexyl) acetate	99	27. Carbitol acetate.....	97
6. Butyl Cellosolve.....	99	17. Butyl Cellosolve acetate....	99	28. Butyl Carbitol.....	96
7. Safe-T-Esso.....	—	18. Butyl lactate.....	97	29. Butyl Carbitol acetate.....	99
8. Cyclohexanol.....	94	19. Glycol diacetate.....	99	30. Diglycol diacetate.....	99
9. Furfuryl acetate.....	99	20. Octyl (2-ethyl hexyl) alcohol	99	31. Benzyl Cellosolve.....	99
10. Tetrahydrofurfuryl alcohol.	99	21. Pine oil.....	—		
11. Acetonylacetone.....	95	22. Methyl Carbitol.....	—		

(3) slow to very slow evaporating liquids have been prepared by Doolittle<sup>16</sup> and are shown in Figures 3, 4, and 5.

**Constant-Evaporating Liquid Mixtures.**—Just as there are constant boiling point liquid mixtures there are also constant-evaporating liquid mixtures. A table given by Hofmann<sup>17</sup> and shown below lists such mixtures.

Generally speaking, constant-evaporating mixtures are not formed by different com-

pounds of the same homologous series but are formed by mixtures of solvents which do not belong to the same homologous series. Just like the rate of evaporation of individual solvents is influenced by many factors, similarly the evaporation behavior of solvent mixtures as used in the lacquer industry is influenced by the different solid ingredients used in lacquers. Some information in this field is given by Dorsch and Stewart.<sup>18, 19</sup>

<sup>16</sup> A. K. Doolittle, *Ind. Eng. Chem.* **27**, 1169 (1935).

<sup>17</sup> H. E. Hofmann, *Ind. Eng. Chem.* **24**, 135 (1932).

<sup>18</sup> J. B. Dorsch and J. K. Stewart, *Ind. Eng. Chem.* **30**, 325 (1938).

<sup>19</sup> J. K. Stewart, J. B. Dorsch, and C. B. Hopper, *Ind. Eng. Chem.* **29**, 899 (1937).

TABLE 10. CONSTANT-EVAPORATING MIXTURES AT 20-25° C.

<i>Ingredient</i>	<i>% by Volume</i>	<i>Ingredient</i>	<i>% by Volume</i>
Benzene.....	47	Ethyl acetate.....	53
Benzene.....	69	Methanol.....	31
Carbon tetrachloride.....	82.6	Ethyl alcohol.....	17.4
Carbon tetrachloride.....	70	Ethyl methyl ketone.....	30
Toluene.....	45	95% Ethyl alcohol.....	55
Toluene.....	48	98% Isopropyl alcohol.....	52
Toluene.....	78	sec-Butyl alcohol.....	22
Toluene.....	92	sec-Amyl alcohol.....	8
Xylene.....	35	sec-Butyl alcohol.....	65
Xylene.....	65	sec-Amyl alcohol.....	35
Xylene.....	70	n-Butyl alcohol.....	30
Xylene.....	80	Fusel oil.....	20
Xylene.....	83	Cellosolve.....	17

**Velocity of Evaporation.**—The velocity of evaporation of liquids was studied by de Heen <sup>20</sup> who found that the evaporation of a liquid into a current of air projected normal to the surface is a different phenomenon from evaporation into a current of air projected tangentially. In the first case the action of a stationary layer of gas resting on the surface of the liquid is negligible; in the second case a stationary layer resting on the surface of the liquid is allowed to exist. The current of gas passed parallel to the liquid surface in the evaporator used by de Heen but did not eliminate entirely the action normal to the surface. As the temperature increases, the velocity of evaporation increases more rapidly than the vapor pressure of the liquid. At a given temperature the weight of liquid which is lost by evaporation varies as the product of vapor pressure and molecular weight. This product was studied for eight different liquids and the following results were obtained:

<i>Solvent</i>	<i>Weight of Liquid Vaporized</i>	<i>Vapor Pressure × Mol. Wt.</i>
		100
Water.....	3.4	3.12
Benzine.....	58.0	58.97
Chloroform.....	178.0	191.79
Acetic acid .....	11.0	11.34
Alcohol.....	23.2	20.24
Ethyl bromide.....	423.0	421.05
Sulfur chloride.....	245.0	226.48
Ether.....	390.0	320.42

In spite of the great variations in this product for the various compounds tested, the weight of liquid evaporated checked within about 10% for all eight liquids. If the weight of liquid evaporated is *S*, if the speed of the gas current is *V*, and if *H* represents a constant, then

$$H = \frac{S}{\sqrt{V}}$$

**Measurement of Evaporation Rates.**—Couleru <sup>21</sup> used a special balance to determine automatically the rate of evaporation of a given solvent. From an examination of the influence of the size and height of the evaporation cup and the temperature he deduced these three laws:

$$\begin{aligned} \log x &= ah^2 + b \\ \log x &= e \log S + f \\ \log x &= c \log T + d \end{aligned}$$

In these equations *x* is the time required to volatilize 2 grams of the solvent, *a*, *b*, *c*, *d*, *e*, and *f* are constants, *h* is the height of the cup, *S* is its evaporating surface, and *T* is the temperature at which the evaporation rate is determined.

The evaporation rates of many solvents were determined by Marwedel and Hauser <sup>22</sup> who used normal propyl alcohol as a reference fluid. They measured the ratio

<sup>21</sup> A. Couleru *Rev. prod. chim.* **40**, 611 (1937).

<sup>22</sup> G. Marwedel and O. Hauser, *Farbe u. Lack* **54**, 115, 175 (1948).

<sup>20</sup> De Heen, *J. chim. phys.* [2] **11**, 205 (1913).

$$\left( \frac{\text{evaporation time of 25\% of solvent}}{\text{evaporation time of 25\% propyl alcohol}} \right) \times 100$$

in experiments conducted under the same conditions of temperature and humidity and observed the percentage loss in weight per minute of 10.00-gram samples of the solvents in crystallizing dishes of an outer height of 0.97 cm. and an inner diameter of 9.72 cm. until 25% of the solvents had vaporized. They found that cooling caused an appreciable decrease in the evaporation rate of these rapidly evaporating solvents: ether, acetone, methanol, and benzene. The percentage decrease in evaporation rate per minute for rapidly evaporating solvents fell off with the heat loss per minute. They used the evaporation rates to calculate the vapor pressures with good agreement for low-boiling solvents.

McArdle and Robertson<sup>23</sup> developed a procedure for measuring evaporation rates

of hydrocarbon thinners by using specific gravities and volatilities as measured by A.S.T.M. distillation procedures. The evaporation index as used by them is the ratio of the time required by a thinner to reach a definite percentage of evaporation to the time required by a standard thinner. The latter is a hypothetical, straight-run petroleum naphtha of 40° boiling range and 50% A.S.T.M. distillation temperature of 80° to reach the same percentage of evaporation. The time necessary to reach a definite percentage of evaporation is calculated from the 50% distillation temperature.

For detailed methods for the measurement of evaporation rates see Jacobs and Scheffan.<sup>24</sup>

<sup>23</sup> E. H. McArdle and A. E. Robertson, *Ind. Eng. Chem., Anal. Ed.* **16**, 690 (1944).

<sup>24</sup> Morris B. Jacobs and L. Scheffan, *Chemical Analysis of Industrial Solvents*. Interscience, New York, 1953.

## Chapter V

# DILUTION RATIOS

The dilution ratio is the ratio by volume of diluent to solvent when a mixture of both diluent and solvent just fails to dissolve nitrocellulose. The value of dilution ratios varies with the nitrocellulose concentration at the completion of the titration. The dilution ratio method measures the tolerance of a solvent for a diluent at the gel point or the precipitation point. The dilution ratio is determined ordinarily by titrating a solution of nitrocellulose in a solvent with a hydrocarbon diluent, e.g., toluene. It is an important factor in evaluating solvents from the protective coating point of view.

$$\frac{V_d}{V_n} = \frac{\text{Volume of diluent}}{\text{Volume of solvent}}$$

The dilution ratio corresponds to the solvent-power numbers defined by Mardles<sup>1</sup> as the volume of the diluent in milliliters necessary to start precipitation from 1 ml. of a 0.05 concentration sol. The dilution ratios of nitrocellulose solvents depend chiefly on these factors: (1) nature of the solvent, (2) nature of the diluent, (3) prevailing temperature, (4) type of nitrocellulose, and (5) concentration of the nitrocellulose in the mixture.

The dilution ratio of nitrocellulose solvents was investigated by Davidson and Reid;<sup>2</sup> it is a measure, as was discussed in Chapter III, of the solvent power of the solvent. From the results of their experimental study Davidson and Reid concluded that: (1) The dilu-

tion ratio is a reasonably accurate measure of solvent power. (2) Other conditions remaining the same, the dilution ratios of nitrocellulose solvents are greater with respect to the aromatic hydrocarbons than to gasolines. (3) The glycol ethers have better dilution ratios with respect to the aromatic hydrocarbons than the butyl esters. With respect to gasoline the ratios are approximately equal. (4) Cracked gasolines are better diluents than straight-run gasolines of the same boiling range. (5) The lower boiling fractions of a given gasoline are better diluents than the higher boiling fractions. (6) The dilution ratio decreases as the concentration of nitrocellulose is increased.

As shown by Doolittle,<sup>3</sup> the value of a solvent for nitrocellulose depends on various factors such as "cost, odor, color, stability, evaporation rate, solvent strength, compatibility with gums and resins, blush characteristics, and flow characteristics." Methods of measuring the solvent strength of solvents were suggested by a number of investigators.<sup>4-10</sup> Of all these methods only two,

<sup>3</sup> A. K. Doolittle, *Ind. Eng. Chem.* **30**, 189 (1938).

<sup>4</sup> F. Baker, *J. Chem. Soc.* **103**, 1653 (1913).

<sup>5</sup> F. Sproxton, Brit. Assoc. Advancement Science, Third Colloid Rept. (1920).

<sup>6</sup> F. Sproxton, *Trans. Faraday Soc.* **16**, Appendix, 78 (1921).

<sup>7</sup> E. W. J. Mardles, *J. Soc. Chem. Ind.* **42**, 127T, 207T (1923).

<sup>8</sup> B. K. Brown and C. Bogin, *Ind. Eng. Chem.* **19**, 968 (1927).

<sup>9</sup> E. G. Davidson and E. W. Reid, *Ind. Eng. Chem.* **19**, 977 (1927).

<sup>10</sup> J. W. McBain, E. M. Grant, and L. E. Smith, *J. Phys. Chem.* **38**, 1217 (1934).

<sup>1</sup> E. W. J. Mardles, *J. Soc. Chem. Ind.* **42**, 129T (1923).

<sup>2</sup> J. G. Davidson and E. W. Reid, *Ind. Eng. Chem.* **18**, 669 (1926); **19**, 977 (1927).

the viscosity method suggested by Baker and the dilution ratio method suggested by Sproxton, are commonly employed in the lacquer industry and relate to the performance of solvents in lacquers. Baker's suggestion<sup>11</sup> of using the viscosity of solutions of nitrocellulose in mixtures of solvents as a measure of the solvent strength of the mixtures was employed later in studies of the viscosities of solutions of nitrocellulose in mixtures by many investigators.<sup>12-21</sup>

Sproxton's suggestion<sup>22</sup> of using the tolerance of the solvent for diluent, called the dilution ratio, as a means of evaluating solvent strength has been followed by many studies<sup>23-33</sup> in this field.

<sup>11</sup> F. Baker, *J. Chem. Soc.* **103**, 1653 (1913).

<sup>12</sup> W. H. Gibson and R. McCall, *J. Soc. Chem. Ind.* **39**, 172T (1920).

<sup>13</sup> I. Masson and R. McCall, *J. Chem. Soc.* **117**, 819 (1920).

<sup>14</sup> E. C. Bingham, *Fluidity and Plasticity*. McGraw-Hill, New York, 1922.

<sup>15</sup> E. W. J. Mardles, *J. Soc. Chem. Ind.* **42**, 127T, 207T (1923).

<sup>16</sup> A. Highfield, *Trans. Faraday Soc.* **22**, 57 (1926).

<sup>17</sup> J. W. McBain, *J. Phys. Chem.* **30**, 239 (1926).

<sup>18</sup> J. W. McBain, C. E. Harvey, and L. E. Smith, *J. Phys. Chem.* **30**, 312 (1926).

<sup>19</sup> E. Hatschek, *Viscosity of Liquids*. Bell and Sons, London, 1928.

<sup>20</sup> K. Atsuki and M. Ishiwara, *Caoutchouc & gutta-percha* **28**, 15, 462 (1930).

<sup>21</sup> J. W. McBain, E. M. Grant, and L. E. Smith, *J. Phys. Chem.* **38**, 1217 (1934).

<sup>22</sup> F. Sproxton, *Brit. Assoc. Advancement Science*, Third Colloid Rept. (1920).

<sup>23</sup> D. B. Keyes, *Ind. Eng. Chem.* **17**, 558 (1925).

<sup>24</sup> J. G. Davidson, *Ind. Eng. Chem.* **18**, 669 (1926).

<sup>25</sup> J. G. Davidson and E. W. Reid, *Ind. Eng. Chem.* **19**, 977 (1927); **20**, 199 (1928).

<sup>26</sup> R. Calvert, *Ind. Eng. Chem.* **21**, 213 (1929).

<sup>27</sup> M. M. Wilson and F. J. Worster, *Ind. Eng. Chem.* **21**, 592 (1929).

<sup>28</sup> R. B. Frazier and E. W. Reid, *Ind. Eng. Chem.* **22**, 604 (1930).

<sup>29</sup> O. R. Brunkow, *Ind. Eng. Chem.* **22**, 177 (1930).

<sup>30</sup> J. G. Park and M. B. Hopkins, *Ind. Eng. Chem.* **22**, 826 (1930).

<sup>31</sup> J. G. Park and H. E. Hofmann, *Ind. Eng. Chem.* **24**, 132 (1932).

<sup>32</sup> A. K. Doolittle, *Ind. Eng. Chem.* **27**, 1169 (1935); **30**, 189 (1938).

<sup>33</sup> A. K. Doolittle, R. E. Smith, and G. R. Penn, *Paint, Oil Chem. Rev.* **99**, No. 10, 26 (1937).

Doolittle<sup>32</sup> made a study of the comparative toluene dilution ratios of pure solvent and solvent coupler mixtures. The values found for the solvent strength of the pure members of the homologous series of acetates, ketones, and ether-alcohols was found to pass through maxima as the homologous series is ascended. However, the ketones showed a continual diminution in solvent strength as the size of the molecules increases.

A number of attempts have been made to find a relationship between the dilution ratios of solvents of homologous series with the aim of being able to extrapolate data found for one or two members of the series to other members of the same series. Thus Desparmet<sup>34</sup> related the solvent strength of 2 ketones to the proportion of oxygen-bearing groups in the molecule of these ketones; later Calvert<sup>35</sup> related the dilution ratios of these ketones to the percentage of oxygen. Solvent strength in homologous series was also related to the molecular weight of these solvents and it was stated that the member with lowest molecular weight had the highest solvent strength. McBain<sup>36</sup> *et al.*, as well as Mardles,<sup>37</sup> showed that the solvent strength criteria found by the dilution ratio method occasionally disagreed with those found by the viscosity method. Davidson and Reid<sup>38</sup> reported that there was no proportionality between the solvent strength and molecular weight of glycol ethers by means of the dilution ratio method. Mardles<sup>39</sup> found that apparently there was no close relation linking the solvent power of a solvent for cellulose esters to the molecular volume. However, Doolittle showed that there was a definite empirical relationship between the

<sup>34</sup> E. Desparmet, *Cuir tech.* **16**, 217 (1927).

<sup>35</sup> R. Calvert, *Ind. Eng. Chem.* **21**, 213 (1929).

<sup>36</sup> J. W. McBain, C. E. Harvey, and L. E. Smith, *J. Phys. Chem.* **30**, 312 (1926).

<sup>37</sup> E. W. J. Mardles, *J. Soc. Chem. Ind.* **42**, 127T, 207T (1923).

<sup>38</sup> J. G. Davidson and E. W. Reid, *Ind. Eng. Chem.* **19**, 977 (1927).

<sup>39</sup> E. W. J. Mardles, *J. Soc. Chem. Ind.* **42**, 127T, 207T (1923).

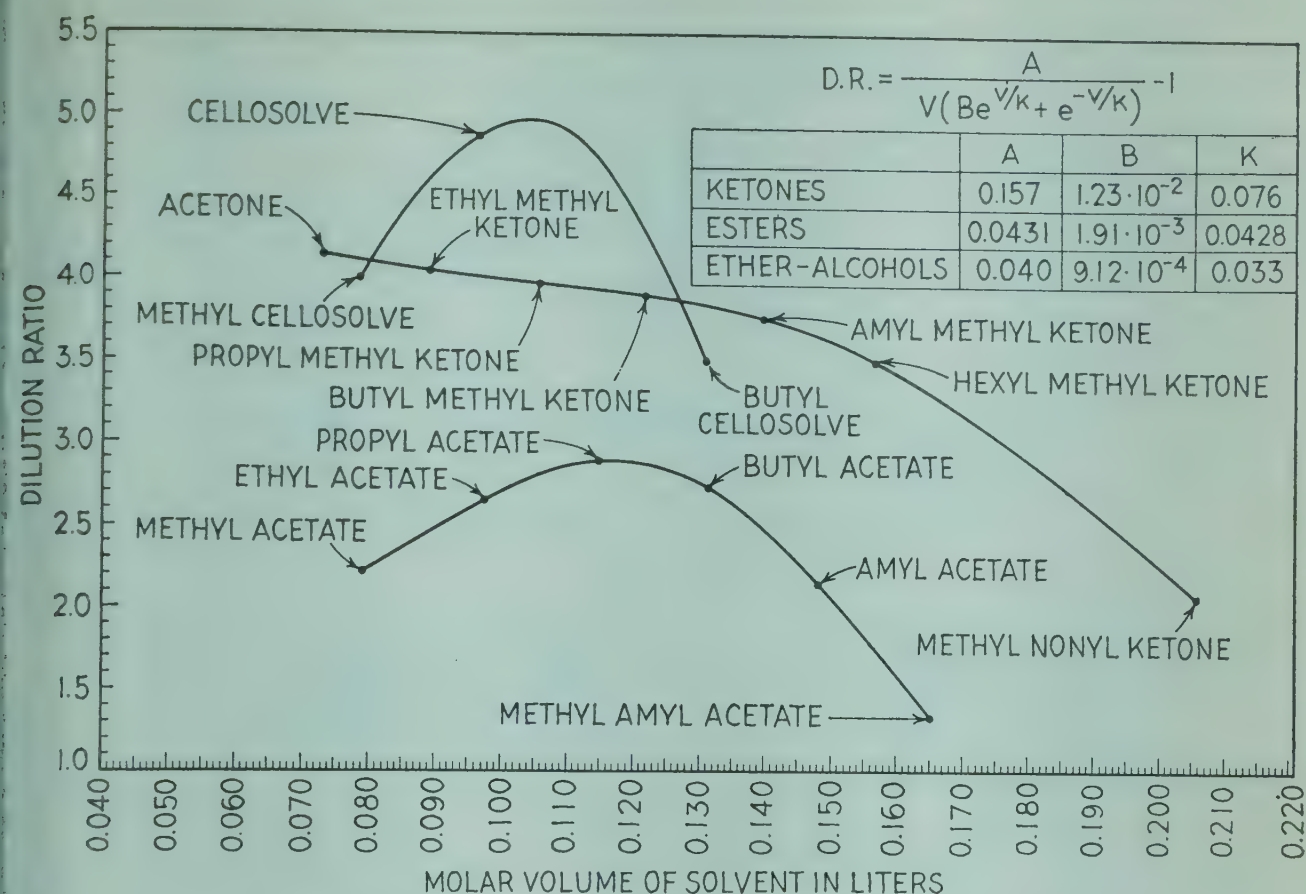


FIG. 6. Solvent Strength of Pure Ketones, Esters, and Ether-Alcohols <sup>a</sup>

<sup>a</sup> After A. K. Doolittle, *Ind. Eng. Chem.* **30**, 189 (1938).

toluene dilution ratios of pure compounds of certain homologous series of ketones, esters, and ether-alcohols. He plotted the toluene dilution ratio data vs. the molar volumes of the solvents. The three quantities,  $N$  = the mol concentration of solvent or solvent + coupler expressed in mols per liter,  $V$  = the molar volume expressed in liters, and  $DR$  = the dilution ratio, are related by the equation

$$N = \frac{1}{V(DR + 1)}$$

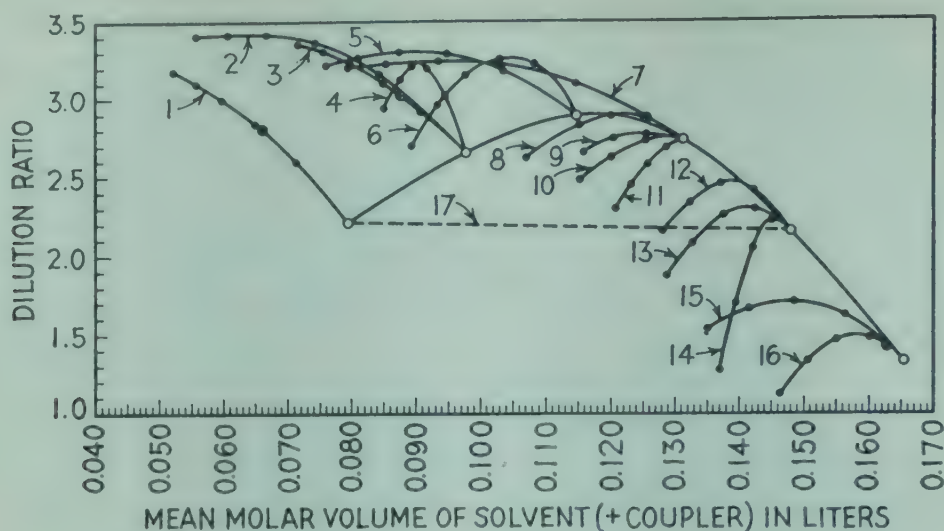
In the three curves shown in Fig. 6 the toluene dilution ratios are connected at an end point of 8% total solid for the ascending members of the homologous series of pure ketones, esters, and ether-alcohols. These curves are defined by the empirical relation

$$DR = \frac{A}{V(Be^{V/k} + e^{-V/k})} - 1$$

in which  $A$ ,  $B$ , and  $k$  are the constants shown in Fig. 6 and in which  $e$  represents the exponential or Napierian base. Figs. 7, 8, and 9 show solvent strength data for esters + coupler, ketones + coupler, and ether-alcohols + coupler respectively.

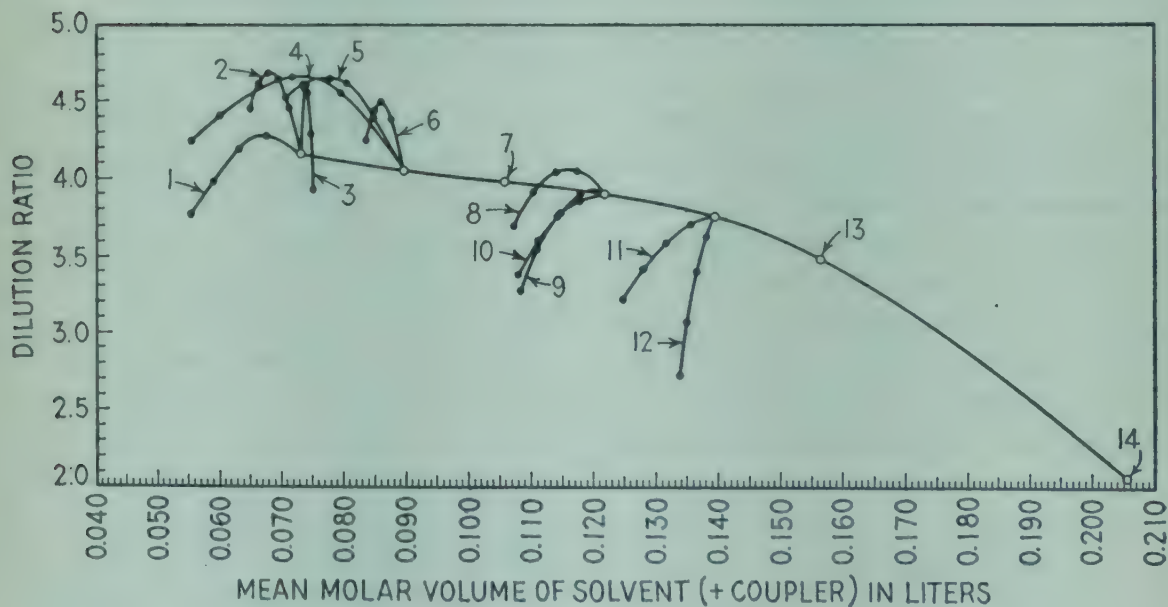
In the case of the comparative toluene dilution ratios of solvent-coupler mixtures Doolittle displayed all of the relations involving each class of solvents on a single chart by plotting all of the dilution ratios against a common variable. This common variable was the mean molar volume of solvent + coupler which is the sum of the parts of the molar volumes of solvent and of coupler represented by the mol proportions in which both of these components are present in the mixture: it is defined by the relationship

$$V = \frac{N_s V_s + N_c V_c}{N_s + N_c}$$

FIG. 7. Solvent Strength of Esters <sup>a</sup>

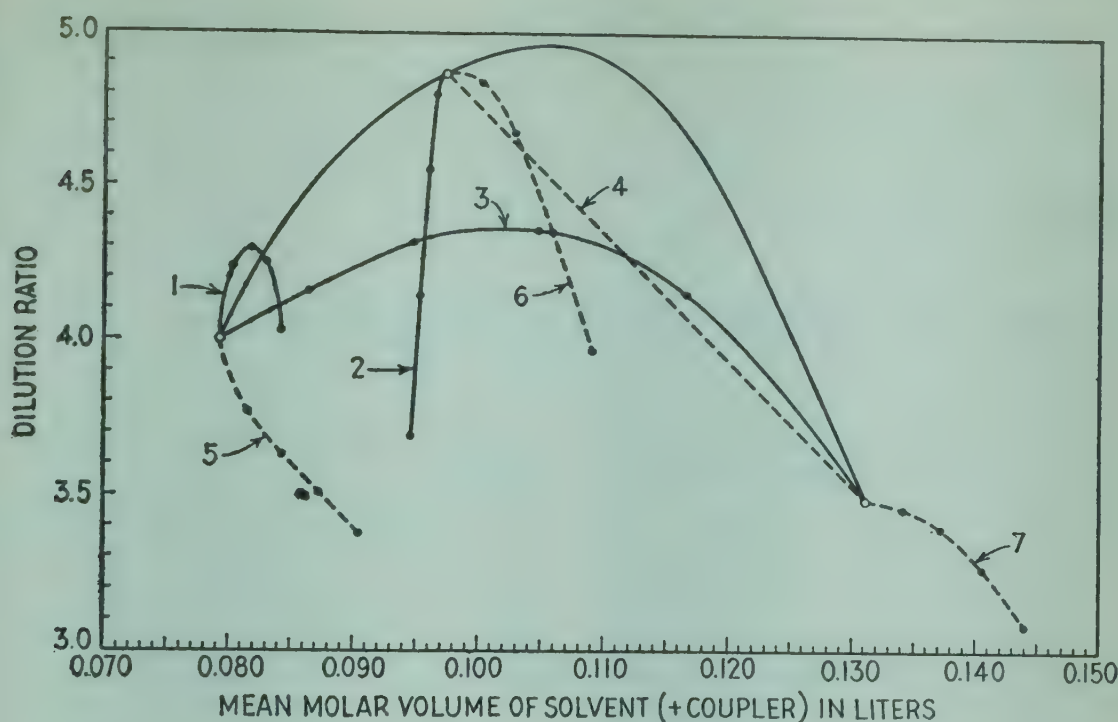
- |                                     |   |
|-------------------------------------|---|
| 1. Methyl acetate-methanol          | 10. Butyl acetate- <i>sec</i> -butanol      |
| 2. Ethyl acetate-methanol           | 11. Butyl acetate- <i>sec</i> -amyl alcohol |
| 3. Ethyl acetate-ethanol            | 12. Amyl acetate-amyl alcohol               |
| 4. Ethyl acetate-isopropanol        | 13. Amyl acetate- <i>sec</i> -amyl alcohol  |
| 5. Propyl acetate-ethanol           | 14. Amyl acetate-2-ethylbutanol             |
| 6. Propyl acetate-propanol          | 15. Methyl amyl acetate-amyl alcohol        |
| 7. Butyl acetate-ethanol            | 16. Methyl amyl acetate-methyl amyl alcohol |
| 8. Butyl acetate- <i>n</i> -butanol | 17. Methyl acetate-amyl acetate             |
| 9. Butyl acetate-isobutanol         |   |

<sup>a</sup> After A. K. Doolittle, *Ind. Eng. Chem.* **30**, 189 (1938).

FIG. 8. Solvent Strength of Ketones <sup>a</sup>

- |                                    |  |
|------------------------------------|--|
| 1. Acetone-methanol                | 8. Butyl methyl ketone- <i>n</i> -butanol      |
| 2. Acetone-ethanol                 | 9. Butyl methyl ketone-isobutanol              |
| 3. Acetone-isopropanol             | 10. Butyl methyl ketone- <i>sec</i> -butanol   |
| 4. Ethyl methyl ketone-methanol    | 11. Amyl methyl ketone- <i>n</i> -amyl alcohol |
| 5. Ethyl methyl ketone-ethanol     | 12. Amyl methyl ketone-methyl amyl alcohol     |
| 6. Ethyl methyl ketone-isopropanol | 13. Hexyl methyl ketone                        |
| 7. Methyl propyl ketone            | 14. Methyl nonyl ketone                        |

<sup>a</sup> After A. K. Doolittle, *Ind. Eng. Chem.* **30**, 189 (1938).

FIG. 9. Solvent Strength of Ether Alcohols <sup>a</sup>

## Ether-Alcohol Coupler Combinations

- |   |  |
|---|--|
| 1. Methyl Cellosolve- <i>n</i> -butanol | 5. Methyl Cellosolve-methyl Cellosolve acetate |
| 2. Cellosolve- <i>n</i> -butanol        | 6. Cellosolve-Cellosolve acetate               |
| 3. Methyl Cellosolve-butyl Cellosolve   | 7. Butyl Cellosolve-butyl Cellosolve acetate   |
| 4. Cellosolve-butyl Cellosolve          |  |

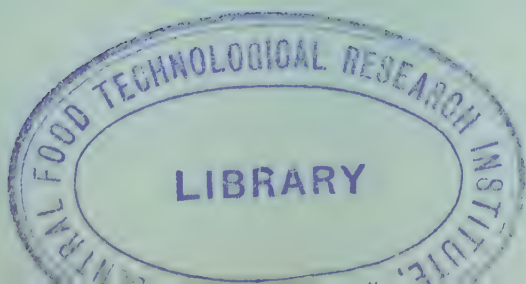
<sup>a</sup> After A. K. Doolittle, *Ind. Eng. Chem.* **30**, 189 (1938).

in which  $V$  represents the mean molar volume of the mixture in liters,  $V_s$  and  $V_c$  are the molar volume of solvent and of coupler respectively in liters, and  $N_s$  and  $N_c$  denote the mol concentration of solvent and of coupler respectively in mols per liter. In Figs. 6, 7, 8, and 9 the dilution ratios of various mixtures of solvent and coupler were plotted at an end point of 8% total solids against the mean molar volumes of the mixtures. Nearly all the curves showing the dilution ratios of

binary mixtures of solvent and alcohol related to their mean molar volumes conform to the same mathematical expression for the pure solvent; the exceptions are ether-alcohol esters mixed with ether-alcohols, the methyl acetate-amyl acetate mixture, and the Cellosolve-butyl Cellosolve mixture.

A tentative A.S.T.M. standard <sup>40</sup> for the determination of dilution ratios was published in 1939.

<sup>40</sup> A.S.T.M. Designation D 268-T, issued 1939.



## Chapter VI

# LIMITS OF INFLAMMABILITY

There has been some confusion regarding the exact meaning and difference between the following terms "explosive limits," "inflammation limits," "flammable limits," "limits of inflammability," and "flammable limits." All of these expressions have been used and indicate the same thing.<sup>1,2</sup> Limits of inflammability are affected by the direction of the propagation of the flame, the construction of the testing apparatus, the temperature and pressure of the mixture under test at the moment of the ignition, the moisture content of the mixture, and the location of the source of ignition.

**Definitions of Explosive Limits.**—The reaction of a gas or vapor with oxygen of the air, resulting in progressive combustion or propagation of flame, occurs only when the concentration of the gas or vapor in the air is within certain limits. When the concentration of the flammable vapor is outside these limits, local combustion may occur at the source of ignition but there is no actual propagation of flame, and the combustion ceases on removal of the source of ignition. The minimum and maximum concentrations of a vapor in air which, if ignited, propagate flame independently of an external source of heat are known as the *lower and upper explosive or flammable limits*. There must also be present a minimum concentration not only of the flammable vapor but also of air or oxygen for the propagation of the flame. These limits are usually expressed in terms

of percentage of vapor or gas in air by volume.

The difference between the lower and upper flammable or explosive limits of a vapor is known as the explosive range. Thus the lower limit of acetone is 2.5% of acetone vapor in air by volume and the upper limit of explosibility is 12.8% of acetone in air by volume. By difference there is an explosive range of approximately 10.3.

**Calorific Value and Limits of Inflammability.**—It was discovered by Burgess and Wheeler<sup>3</sup> that there exists a relationship between the calorific value of the combustible and the lower limit of inflammability. Thus

$$\text{Calorific value of pure paraffin hydrocarbons} \times \text{Lower limit of inflammability} = A \text{ constant}$$

A lower limit mixture of any paraffin hydrocarbon with air produces during combustion the same amount of heat; this fact is utilized in many "hot wire" combustible gas indicators. Relationships between the upper limit of inflammability and the amount of oxygen needed for combustion were discovered by Thornton<sup>4</sup> who found that for paraffins the upper limit of inflammability contained twice as large a gas volume as the mixture for perfect combustion. The corresponding figures were three times the volume for acetylene and carbon disulfide, four times the volume for hydrogen, and six times the volume for carbon monoxide.

<sup>1</sup> J. W. Jones, *Chem. Revs.* **22**, 1 (1938).

<sup>2</sup> S. H. Ash and E. W. Felegy, *U. S. Bur. Mines, Bull.* **471** (1948).

<sup>3</sup> M. J. Burgess and R. V. Wheeler, *J. Chem. Soc.* **99**, 2013 (1911).

<sup>4</sup> W. M. Thornton, *Phil. Mag.* **33**, 190 (1917).

Relationships between the calorific value of the combustibles, the oxygen required for perfect combustion, and the limit of inflammability were studied also by White<sup>5</sup> who found that, in the case of all solvents studied except one, the lower limit of inflammability for downward propagation of flame was approximately inversely proportional to the net calorific value of the vapor. The corresponding upper limit follows approximately a similar rule and is about 3.5 times the lower limit. He found also that the amount of oxygen available for the vapor combustion in its limit mixture bears a pretty constant ratio to the amount needed for perfect combustion of one mole of vapor. There is no general relationships of the limit of inflammability of combustible vapors and gases either to the amount of oxygen needed for theoretical complete combustion or to the calorific value of the gases of vapors. However, if the combustibles are classified on the basis of types of compounds, then the relationship between limit of inflammability and oxygen required for theoretical complete combustion is helpful in predicting the limit of inflammability of new combustibles for which the limits of inflammability have not yet been determined.

**Calculation of Limits of Inflammability.**—The limits of inflammability of combustible mixtures can be calculated from the limits of each combustible in air and the percentage of each combustible in the mixture by the use of the so-called "mixture law" as first applied by Le Chatelier and Boudouard.<sup>6</sup> According to this law the mixing of separate limit combustible-air mixtures produces a limit mixture and can be expressed as follows in its simplest form:

$$L = \frac{100}{\frac{P_1}{N_1} + \frac{P_2}{N_2} + \frac{P_3}{N_3} + \frac{P_4}{N_4}}$$

In this equation  $P_1$ ,  $P_2$ ,  $P_3$ , and  $P_4$  represent proportions of each combustible gas or vapor in the original mixture free from air or inert ingredients while  $N_1$ ,  $N_2$ ,  $N_3$ , and  $N_4$  represent the lower limits of inflammability for each combustible in air; furthermore,  $P_1 + P_2 + P_3 + P_4 = 100$ . This law holds for hydrogen, carbon monoxide, and methane containing no inert gases in normal air<sup>7</sup> and holds also for paraffin hydrocarbons in air.<sup>8</sup> It does not hold either for the following mixtures hydrogen-ethylene-air, acetylene-hydrogen-air, hydrogen sulfide-methane-air, and mixtures containing carbon disulfide<sup>9</sup> nor for mixtures of methane-dichloroethylene-air.<sup>10</sup> This law is only approximately correct for mixtures of methyl and ethyl chlorides.<sup>11</sup>

**Elimination of Fire Hazard.**—As practical means of eliminating or minimizing explosions in industrial operations Jones<sup>12</sup> makes the following recommendations:

1. Control the oxygen content of the atmosphere.
2. Carry out operations so that the percentage of combustibles present are outside of their limits of inflammability.
3. Use less inflammable combustibles.
4. Eliminate ignition sources.
5. Segregate hazardous operations.
6. Provide adequate ventilation.
7. Construct fireproof floors.
8. Use adequate lightweight release diaphragms.
9. Use recorders for determining the concentration of combustibles in hazardous atmospheres.

<sup>7</sup> H. F. Coward and G. W. Jones, *U. S. Bur. of Mines, Bull.* **503**, (1952).

<sup>8</sup> H. F. Coward, G. W. Jones, C. J. Dunkle, and B. E. Hees, *Mining Met. Investigations, Carnegie Inst. Tech. Bull.* **30** (1926).

<sup>9</sup> A. G. White, *J. Chem. Soc.* **121**, 1244, 1688, 2561 (1922).

<sup>10</sup> H. F. Coward and G. W. Jones, *Ind. Eng. Chem.* **22**, 963 (1930).

<sup>11</sup> G. W. Jones, *Ind. Eng. Chem.* **20**, 367 (1928).

<sup>12</sup> G. W. Jones, *Chem. Revs.* **20**, 367 (1928).

<sup>5</sup> A. G. White, *J. Chem. Soc.* **121**, 1244, 1688, 2561 (1922).

<sup>6</sup> H. Le Chatelier and O. Boudouard, *Compt. rend.* **126**, 1344, 1510 (1898).

Burlot and Schwob<sup>13</sup> made an investigation of the limits of inflammability of gaseous mixtures from solvent recovery. They concluded that normal operating conditions are well under the limits of inflammability. The chief danger is the enrichment of mixtures with oxygen attributable to air leakage. An important factor influencing the inflammability limit is the hygroscopic condition of the air entering the recovery apparatus.

Dangers from static electricity in the handling of solvents were pointed out by Bachhaus,<sup>14</sup> and later by Morris.<sup>15</sup> Static electricity may develop when (1) a solvent flows through pipes, air, or another gaseous medium, (2) solvent vapor is discharged into air or some other gaseous medium, or (3) a

<sup>13</sup> E. Burlot and R. Schwob, *Mém. poudres* **25**, 336 (1932-33).

<sup>14</sup> A. A. Bachhaus, *Am. Dyestuff Rept.* **16**, 645, 660 (1927).

<sup>15</sup> J. T. Morris, *Chem. Met. Eng.* **43**, 484 (1936).

gas passes through a liquid solvent. The danger is small for solvents which are good conductors when flowing through pipes. The pipe lines must be good conductors and well grounded when the solvents are poor conductors. In the latter case sprays should be avoided if at all possible by discharging the solvent at the lower end of the receiver. If this cannot be avoided, then the air should be ionized by moisture, X rays, or ultraviolet light.

The effects of volatility, saturation, evaporation, molecular weight, temperature, boiling point, flash point, and explosibility of solvents were studied by Thormann<sup>16</sup> in relation to the potential danger in the use of these solvents and he showed that this danger may be increased or decreased by the selection of the mixtures employed.

<sup>16</sup> Thormann, *Zentr. Gewerbehyg. Unfallverhütung* **18**, 67 (1931); **19**, 11 (1932).

## Chapter VII

# SOLVENT RECOVERY

In modern manufacturing and processing operations tremendous amounts of solvents of various types are used all over the world for various purposes such as dissolving, extracting, cleaning, and the like. During many industrial operations some of the solvent is lost by vaporization into the atmosphere; in other industrial operations the solvents slowly become contaminated and eventually are rendered unsuitable for use. The need for eliminating the loss of solvents, the desire to facilitate manufacturing and processing operations, the importance of decreasing the fire hazard inherent in the use of inflammable liquids, and finally the necessity of excluding any health hazards arising from possible exposures to these solvents has led to various types of processes developed to recover solvents and make their re-use possible. Furthermore, in those cases where a choice exists between a less expensive and less efficient solvent and a more expensive and more effective solvent the use of a modern, efficient recovery process makes possible the choice of the better solvent, for it eliminates the cost of the solvent as an important factor in the selection of the solvent to be used, and often brings about a decided improvement in the quality of the product and the speed of the manufacturing operation.

All of the solvent recovery processes known so far make use of one or more of the following operations: condensation, compression, adsorption, absorption, and distillation. The solvent recovery process is thus

applied to the gaseous waste product resulting from most industrial operations in which solvents are involved; the waste product consists of a mixture of solvent vapor and air varying greatly in composition, and the concentration of the vaporized solvent in this gaseous waste product is usually low.

### SOLVENT RECOVERY IN GENERAL

According to Ray,<sup>1</sup> to evaluate any method of solvent recovery one must first consider if its characteristics will permit safe operation. Other important criteria by which a recovery process may be evaluated are: recovery efficiency, recovery expense, flexibility to meet varied operating conditions, and relation between initial cost and saving.

The literature contains many articles dealing with general and specific problems of solvent recovery. A number of these articles are listed below:

- Q. Sestini, *Ann. chim. applicata* **10**, 117 (1918).  
P. Razous, *L'Industrie Chimique* **6**, 169, 195, 229, (1919).  
A. D. Luttringer, *Caoutchouc et gutta-percha* **22**, 12,627, 12,671, 12,858 (1925).  
J. H. Bregeat, *Caoutchouc et gutta-percha* **24**, 13,407 (1927).  
St. Reiner, *Kautschuk* **1927**, 31, 77.  
C. Heinel, *Apparatebau* **39**, 129 (1927).  
H. Molinari, *Giorn. chim. ind. applicata* **9**, 571 (1927).  
G. Genin, *Rev. gén. mat. plastiques* **4**, 459, 707 (1928); **5**, 257, 317, 571 (1929).  
A. Boecler, *Rev. gén. caoutchouc* **6**, No. 49, 18 (1929).

<sup>1</sup> A. B. Ray, *Chem. & Met. Eng.* **47**, 329 (1940).

- J. Bodewig, *Chem. Fabrik* **1929**, 471, 479.  
 L. Piatti, *Kautschuk* **5**, 230, 255 (1929).  
 A. Aleš, *Chem. Listy* **23**, 1 (1929).  
 I. L. Murray, *Ind. Eng. Chem.* **22**, 165 (1930).  
 E. Schlenker, *Gummi-Ztg.* **45**, 1859 (1931).  
 N. S. Puzhai, *J. Chem. Ind. (Moscow)* **8**, No. 20, 5; No. 21-22, 12; No. 23-24, 5 (1931).  
 J. C. Liddle, *Chem. Age (London)* **26**, 87 (1932).  
 L. Piatti, *Nitrocellulose* **3**, 121 (1932).  
 E. Sutcliffe, *Inst. Rubber Ind. Trans.* **8**, 66 (1932).  
 W. L. Brogan, *Chem. Eng. Mining Rev.* **25**, 88 (1932).  
 E. Klapper, *Allgem. Öl, Fett-Ztg.* **29**, 169 (1932).  
 E. Wurm, *Gummi-Ztg.* **47**, 487 (1933).  
 J. Lloyd, *Trans. Inst. Rubber Ind.* **8**, 418 (1933).  
 J. C. Liddle, *Trans. Inst. Rubber Ind.* **8**, 422 (1933).  
 S. R. Price, *Chem. Age (London)* **28**, 478 (1933).  
 H. Griffiths, *Chem. Age (London)* **28**, 482 (1933).  
 J. G. M. Bevan, *Chem. Age (London)* **28**, 485 (1933).  
 L. Piatti, *Kunststoffe* **24**, 6 (1934).  
 E. Boye, *Chem.-Ztg.* **58**, 1017 (1934).  
 A. Foulon, *Fettchem. Umschau* **41**, 25 (1934).  
 L. Musso, *Industria chimica* **9**, 1489 (1934).  
 A. P. Okatov, *Trans. VI Mendeleev Congr.* **1932**, II, 1, 237 (1935).  
 A. Angelhardt, *Kolloid-Z.* **71**, 236, 335 (1935).  
 L. Piatti, *Nitrocellulose* **6**, 47 (1935); **7**, 42 (1936).  
 E. Schwarz, *Kautschuk* **12**, 15 (1936).  
 A. E. Williams, *Engineer* **162**, 676 (1936).  
 L. Piatti, *Nitrocellulose* **8**, 35 (1937); **9**, 15 (1938).  
 C. A. Bulkeley, *Chem. & Met. Eng.* **45**, 300 (1938).  
 G. P. Tolstoi, *Org. Chem. Ind. (U.S.S.R.)* **5**, 174 (1938).  
 G. Génin, *Tech. ind. chim.* No. 277 bis, 163 (1938).  
 H. Griffiths, *Chem. Age (London)* **40**, 473 (1939).  
 L. Piatti, *Nitrocellulose* **10**, 83 (1939).  
 A. P. Okatov, *Org. Chem. Ind. (U.S.S.R.)* **6**, 424 (1939).  
 B. N. Rutovskii and A. N. Levin, *Org. Chem. Ind. (U.S.S.R.)* **7**, 158 (1940).

Many other references are given in the text.

One step which has been suggested as a general pretreatment in solvent recovery is to lead the current of vaporized solvent

mixed with air or gas from which the solvent vapors are to be recovered by means of a suitable equipment so that the current is first washed with the solvent to be recovered<sup>2</sup> before it passes into the recovery apparatus. In this way solid particles are removed as well as vapors which are ordinarily in the solid state. This precaution eliminates any possible clogging of the recovery apparatus proper.

## CONDENSATION

Whereas evaporation or vaporization is the process of converting a liquid into a vapor by heat absorption, condensation is the process of converting a vapor into a liquid

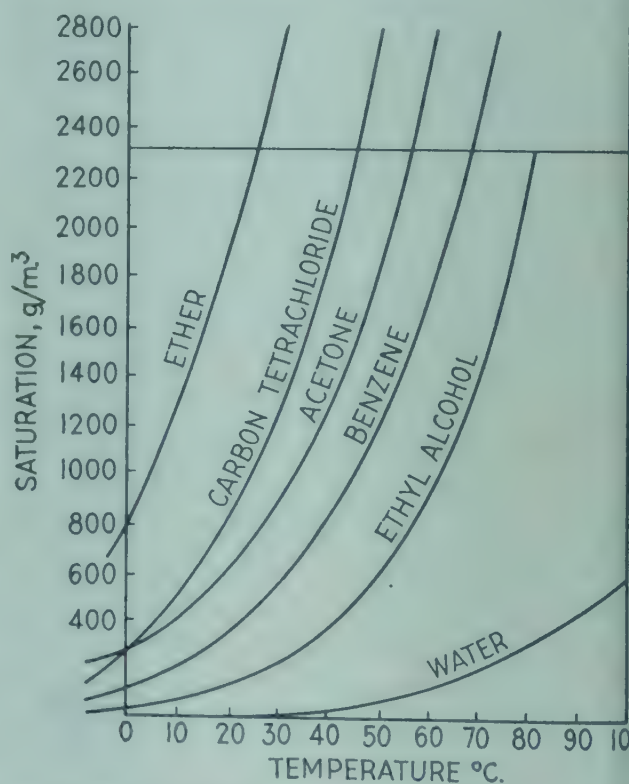


FIG. 10. Saturation Curves of Some Solvents<sup>a</sup>

<sup>a</sup> After H. Gnam, *Die Lösungsmittel und Weichhaltungsmittel*. Edwards, Ann Arbor, Mich., 1945.

by heat removal or cooling. Thus condensation is just the opposite of evaporation or vaporization. Vaporized solvents can be condensed by cooling the mixture of vapor and gas below the dew point. This can be brought about by letting the vapor-gas mixture come

<sup>2</sup> Cheminova Gesellschaft für Verwertung chemischer Abfälle, Verfahren m. b. H. Ger. 485,500, March 6, 1928.

in indirect or direct contact with a suitable cooling surface. As shown in typical saturation curves, Fig. 10, the cooling of vaporized solvents can cause condensation and separation of the vapors from the vapor-air mixture; however, it should be noted that no matter how efficient the cooling method is, condensation will never remove all of the vaporized solvent from the air. In other words, solvent recovery by condensation is seldom really complete.

If water is used as the cooling medium, the temperature can be lowered usually only to about 60° F. At this temperature most inflammable solvents have vapor pressures which produce minimum air-vapor concentrations in or above the explosive range. This hazard can be eliminated by replacing the air with an inert atmosphere. Under such conditions a large amount of vapor is left uncondensed and it becomes necessary to recirculate the vapor mixture in order to prevent the loss of excessively large amounts of solvent. In the condensation process atmospheric moisture may be condensed also which may make it necessary to distill the condensate if the solvent condensed is water soluble.

The condensation process of solvent recovery has the possible advantages that it is particularly applicable in those cases where the material to be processed can be kept in a high concentration of vaporized solvent; because, however, of its low efficiency and other disadvantages it is not used very widely in industry.

Depending upon the conditions of temperature and pressure, a volatile substance may occur either as vapor (gas) or liquid or in both of these states of matter. It may occur under certain conditions of temperature and pressure as vapor alone, in the superheated condition, if the temperature is sufficiently high and the pressure is sufficiently low. It may occur together as liquid and vapor at a variety of temperatures with the vapor pressure depending on the prevailing temperature.

In solvent recovery by condensation (at constant pressure) the state of matter of the solvent is changed from the gaseous to the liquid state by indirect or direct contact between the vaporized solvent and a suitable cooling medium and, if necessary, by a reduction in pressure.

Solvent recovery by condensation is probably applicable only to mixtures containing at least 200 grams of solvent per cubic meter of air. Condensations are generally carried out with a suitable refrigerant at temperatures not lower than 10° C., since much lower temperatures may produce ice in the pipes. Condensation recovery processes at times require expensive installations and a comparatively large staff of operating personnel.

The principles of the recovery of volatile solvents by condensation are discussed by Weissenberger<sup>3</sup> with particular emphasis on the recovery of acetone by cooling. While self-contained drying systems provided with external or internal circulation of the drying gases make possible better recovery by the condensation process than those drying systems which function by means of a continuous draft, they should be used with much greater caution because of the increased safety hazard. It is pointed out also that the yield from any condensation process is necessarily lower than that from an absorption or adsorption process.

According to Bregéat,<sup>4</sup> vaporized inflammable solvents may be condensed by bringing the vapors directly in contact with blocks of compressed solid carbon dioxide; in this process gaseous carbon dioxide is liberated, which in turn acts as a means of preventing the occurrence of fire.

A suitable apparatus for the recovery of volatile solvents from gases by condensation is shown by Boecler, Bratring, and Giebmann.<sup>5</sup>

<sup>3</sup> G. Weissenberger, *Kautschuk* 1927, 162.

<sup>4</sup> H. Bregéat, Ger. 520,076, August 28, 1928.

<sup>5</sup> A. Boecler, K. Bratring, and A. Giebmann, Ger. 542,352, April 9, 1929.

Boecler<sup>6</sup> compared the recovery of solvents by condensation with that by adsorption and absorption and indicated that the lower yield may be more than offset by lower costs. The danger from explosion is serious; however, this risk can be avoided by (1) using a vapor concentration which is greater than the maximum concentration for ignition, and (2) preventing electrical charges from accumulating in the apparatus. The latter is done by (a) ionizing all parts with the vapor, (b) employing a high-tension discharge, and (3) using radioactive salts.

In a physico-chemical study of solvent recovery by condensation Ponchon<sup>7</sup> used a mixture of alcohol and ether as an example to illustrate the conditions for the most complete recovery of solvents by this method under economical conditions. If the vapor is sufficiently concentrated in the atmosphere, then an appreciable amount of ether may be recovered by cooling with water. The use of a vacuum is helpful.

### ABSORPTION

Vaporized solvents can be recovered from vapor-air mixtures by absorption in liquids. The vapor is brought into close contact with a liquid absorbent at the proper temperature in such a way that the vaporized solvent is extracted as completely as possible from the atmosphere. The liquid used for such purposes must be capable of dissolving the vapor. Such liquid absorption is usually carried out by means of scrubbing towers or spray chambers. Depending upon whether the solvent to be recovered is either water soluble or oil soluble, the liquid absorbent may either be an aqueous solution or water itself, or an oil-dissolving material like mineral oil. In both instances the solvent is held in solution in compliance with Henry's law which has been discussed in Chapter IV. In those cases in which there is no chemical interactions between the solvent and the ab-

sorbent, the amount of solvent which can be recovered by liquid absorption depends entirely on the concentration of the vapor in the air which comes in contact with the absorbing liquid. Absorption is, however, sometimes ascribed to a loose type of chemical combination instead of to solution.

Solvent recovery by absorption has these advantages over solvent recovery by condensation: (1) higher recovery, (2) applicability to a larger number of solvents and greater variation in concentrations, (3) simpler equipment, and (4) lower cost.

Lombardi-Cerri<sup>8</sup> calculated the properties of an absorbing liquid for use in the recovery of a volatile solvent and listed certain important factors in the recovery of volatile solvents with absorbing liquids: (1) The molecular weight of the absorbent should be low. Most vegetable oils are low in efficiency because of their high molecular weight; on the other hand, many commercial absorbents are high in efficiency because of their low molecular weight and not because of the occurrence of any complex chemical reactions. (2) The boiling point of the absorbing liquid should be far apart from that of the solvent. In that case the amount of solvent fixed is in inverse proportion to the molecular weight of the absorbing liquid. (3) The temperature of the absorbent should be kept low and constant during the liquid absorption by proper cooling.

The absorption of organic solvents by washing liquids was investigated by Berl and Ranis<sup>9</sup> who determined vapor pressure-composition curves and heats of mixing of various organic liquid mixtures. The relationships between vapor pressure and concentrations of organic liquids absorbed by cresol, sulfuric acid, and paraffin oil were determined by the use of the Haber-Löwe gas interferometer. In addition, determinations were made of the heat of mixing of various

<sup>8</sup> V. Lombardi-Cerri, *Industria chimica* **9**, 165 (1934).

<sup>9</sup> E. Berl and L. Ranis, *Z. angew. Chem.* **43**, 600 (1930).

<sup>6</sup> A. Boecler, *Chem.-Ztg.* **59**, 495 (1935).

<sup>7</sup> M. Ponchon, *Chimie & industrie* **1**, 481 (1918).

pairs of liquids. Theoretical vapor pressures were calculated using Planck's formula based on the assumption of a process of solution without any chemical reaction. The pairs of liquids studied were placed into three groups: (1) those with partial pressures in accordance with the formula; (2) those with partial pressures greater than the theoretical value, caused by decomposition of associated molecules; and (3) those with partial pressures smaller than the theoretical value, caused by compound formation. Some supporting evidence is shown by the linear, convex, or concave partial pressure-concentration curve as well as the heat evolved on mixing. Contradictory results, found when different methods were used, were explained by the occurrence of both dissociation and chemical combination. The most efficient absorbents found were those which lower the vapor pressure of the more volatile liquid. From their study of (a) the shape of the vapor pressure curve, (b) the position of this curve in relationship to the corresponding theoretical curve, and (c) the values found for the heat of mixing, they concluded that there is a possible difference between a true solution and absorption of one component by another.

**Inorganic Absorbing Solutions.**—Absorbents which have been used in solvent absorption processes can be placed into two major groups, namely, (1) inorganic absorbing solutions such as weakly acidified water or water itself, brine solutions, sodium bisulfite, and sulfuric acid; and (2) organic solvents such as ethyl, butyl, and amyl alcohols; animal, mineral, vegetable, heavy gas, and coal-tar oils; emulsions of linseed oil and water; and cresols.

For example, water has been used for the recovery of ketones. *Sodium bisulfite*, which is used for acetone, has several disadvantages, for it gives poor yields, permits the liberation of free sulfur dioxide, must be re-concentrated, and requires considerable skill in its use. These disadvantages are also true for acidified water and brine absorbing solu-

tions. Sulfuric acid, on the other hand, requires expensive lead-lined equipment.

**Brine Solutions.**—Aqueous solutions of salts having the property of reacting with a solvent to form an addition compound which can subsequently be decomposed at higher temperatures can be used for recovery of solvents by absorption. Thus, calcium chloride increases greatly the absorption of vaporized alcohol by water.

**Lithium Chloride.**—Bichowsky<sup>10</sup> recovered volatile solvents from gases by bringing the mixture containing a carrier gas as air plus the vaporized solvent into contact with a concentrated aqueous solution of lithium chloride, then driving off the absorbed solvent and condensing it.

**Sulfuric Acid.**—Berthélemy<sup>11</sup> studied the recovery of volatile solvents used in the manufacture of plastics, artificial silk, etc., and found that the absorption capacity of sulfuric acid for ether is a function of its specific gravity. If the atmosphere contains only a few parts of ether per 1000, 66° Bé sulfuric acid (specific gravity 1.84) absorbs only approximately 1 mol of ether; acid containing one or more mols of water will absorb little or no ether. An equimolecular mixture of concentrated sulfuric acid and ether can be freed from ether by passing through it a current of moist air after proper hydration of the acid, in accordance with the French patent 350,298. Carbon disulfide can be recovered by absorption as potassium xanthate by means of alcoholic potassium hydroxide; vaporized benzene or toluene can be absorbed by hot, concentrated sulfuric acid or a mixture of sulfuric acid and nitric acid, producing in the case of toluene, toluenesulfonic acid or *p*-nitrotoluene.

**Sulfuric and Phosphoric Acids.**—Good absorption media for acetone according to Ormandy<sup>12</sup> are highly concentrated sulfuric and

<sup>10</sup> F. R. Bichowsky (to Dow Chemical Company), U. S. 2,129,299, September 6, 1938.

<sup>11</sup> H. Berthélemy, *Mat. grasses* 7, 4208, 4236, 4240, 4247, 4231 (1914).

<sup>12</sup> W. R. Ormandy, *Trans. Inst. Chem. Eng.*, Dec. 5, 1929, 10.

phosphoric acids; however, the same acids in dilute solutions are only slightly better absorbents than is water. Although concentrated phosphoric acid is better in many ways than concentrated sulfuric acid, the problem of selecting a suitable material of construction which will withstand the action of hot acid is greater in the case of the phosphoric acid. The use of sulfuric acid, d. 1.70, is recommended for this reason. When a current is used containing 24 grams per cubic meter of acetone, the acid discharged from the scrubbing tower consists of two volumes of acid (d. 1.64) and one volume of acetone. After diluting this mixture to a density of 1.45 the acetone may be recovered by distillation. It is necessary to cool the air during the washing operation to temperatures below 25° C. Vapor pressure data indicate that in 98% acid an addition compound is formed having the formula  $(\text{CH}_3)_2\text{CO} \cdot 2\text{H}_2\text{SO}_4$  which is decomposed readily by the addition of small amounts of water.

**Organic Absorbing Solutions.**—*Alcohols.*—Bassett and Sadtler<sup>13</sup> disclosed that vapors of volatile solvents, e.g., ethyl ether, which are insoluble in water but are soluble in dilute alcohol can be recovered by absorbing them in 40–70% alcohol.

Barbet<sup>14</sup> recovered petroleum, gasoline, alcohol, ether, and similar vapors from aeroform mixtures by passage into a column filled with an appropriate liquid absorbent. In addition some of this liquid absorbent was introduced into the column while the aeroform was passed through it.

Amyl alcohol like various oils used for ether-alcohol absorption has not been very successful as no definite equilibrium is established.

*Oils.*—Mention has already been made of the use of mineral, vegetable, and other oils for the recovery of solvents by absorption. Coal-tar oils of a boiling point of 200–350° C.

are suitable for benzene, toluene, and xylene.

Sadtler<sup>15</sup> recovered vaporized ether or acetone by absorption in a mixture of sperm oil 50, lard oil 25, light petroleum oil 25 and alcohol 25 parts, followed by distillation.

*Cresol and the Bregéat Process.*—The use of cresol as well as sulfuric acid for the recovery of vapors of ether and alcohol highly diluted with air is discussed by Masson and McEwan.<sup>16</sup> They found Henry's law to apply in this case and defined the coefficient  $k$  as the equilibrium ratio between the weight of substance dissolved per kilogram of cresol and the weight remaining as vapor per cubic meter of air.

Bregéat<sup>17</sup> found that vapors of methyl and amyl alcohol, ethyl and amyl acetate, carbon tetrachloride, chloroform, di-, tri-, and tetrachloroethylene, tetra- and pentachloroethane and gasoline can be recovered by absorption in phenolic reagents as crude carbolic acid or crude cresols followed by distillation and condensation. Later he found that phenols, particularly crude cresols,<sup>18</sup> are suitable absorbents for the recovery of vapors such as ether, ethyl, methyl and amyl alcohol, acetone, carbon disulfide, chlorinated hydrocarbons, and various hydrocarbons such as benzene, toluene, xylene, etc. He also showed that a gaseous mixture containing vaporized solvents such as alcohol, benzene, ether, or gasoline can be recovered by absorbing the solvent in a medium containing hydrogenated naphthalene<sup>19</sup> followed by later removal of the absorbed solvent from the absorbent.

Additional patents by Bregéat in this field are Brit. 251,492, July 30, 1925, and U. S. 1,663,155, March 20, 1928, in which he disclosed that hydrogenation products of alicyclic compounds such as pinene or oil of turpentine are suitable washing liquids for absorbing vapors of volatile liquids from natural gases or gases from the distillation

<sup>15</sup> S. S. Sadtler, U. S. 1,365,791, Jan. 18, 1921.

<sup>16</sup> I. Masson and T. L. McEwan, *J. Soc. Chem. Ind.* **40**, 32T (1921).

<sup>17</sup> J. H. Bregéat, Brit. 128,640, Aug. 21, 1917.

<sup>18</sup> J. H. Bregéat, U. S. 1,315,700, Sept. 9, 1919.

<sup>19</sup> J. H. Bregéat, U. S. 1,513,153, Oct. 28, 1924.

<sup>13</sup> H. P. Bassett and S. S. Sadtler, U. S. 1,395,940; Nov. 1, 1921.

<sup>14</sup> E. A. Barbet, U. S. 1,452,778; April 24, 1923.

of coal, lignite, peat, schist, or the like.

The Bregéat process of solvent recovery by absorption covered by various American and European patents is discussed by Blockmann,<sup>20</sup> Bregéat-Aktiengesellschaft,<sup>21</sup> Hock,<sup>22</sup> and others. In this process as mentioned, cresol is used to extract and dissolve the solvent from the atmosphere by intimate contact inside of a closed system of absorption towers using the countercurrent principle. After the solvent has been absorbed, it is expelled by subjecting the mixture to heat in stage evaporators. After separation, the solvent as well as the cresol can be used all over again. The solvent recovery is at first 90–93% but becomes lower gradually because of an increase in the viscosity of the cresol caused by gradual resinification. This resinifying of the cresol is caused by contamination of the cresol with volatile acids, industrial dust, ozone, hydrogen peroxide, and other substances or materials.

According to Hock, cresol is a generally applicable absorbent for volatile solvents which are miscible with water, particularly ether-alcohol vapors, acetone, and the like. The absorption leads to the formation of compounds having decomposition temperatures above that of the solvent and below that of cresol. The scrubber used in the recovery system must be cooled. While cresol may also be used for solvents immiscible with water, the use of tetralin is preferred in those cases. If tetralin is used as an absorbent for benzene, it offers the advantage of neither resinifying nor increasing in viscosity.

*Toluene and Coal-Tar Derivatives.*—Volatile solvents contained in a gaseous mixture may be recovered<sup>23</sup> by lowering the temperature and introducing into this mixture another liquid which does not freeze at this lowered temperature and which lowers the

freezing point of the solvents which are to be extracted. A suitable liquid absorbent for various solvents to be recovered is toluene.

In the case of mixtures of solvent vapors such as benzene with gases the vapors of the solvent can be recovered<sup>24</sup> from the mixture by washing the mixture with fractions having boiling points below 200° C. and taken from products obtained during the catalytic hydrogenation of oxides of carbon. Such gaseous mixtures containing vaporized benzene can be processed<sup>25</sup> also with a by-product having a boiling point greater than 200° C. which is obtained in the acatalytic hydrogenation of oxides of carbon; this complex mixture consists of high molecular weight alcohols together with considerable quantities of various aldehydes, esters, ketones and other organic oxygen compounds.

In the process of extracting hydrocarbon vapors with a liquid solvent, the loss of solvent with the raffinate may be minimized by injecting a second solvent, boiling at 25 to 200° F. below the hydrocarbon, at the top of the extractor. The second solvent should be miscible with the extracting solvent and insoluble in the hydrocarbon. Thus in the extraction of toluene from naphtha with phenol, by means of the addition of 24 to 41% of water, based on the volume of the hydrocarbon overhead, a reduction of the phenol content of the raffinate of 87% results.<sup>25a</sup>

*Acetone · Oil and Aniline.*—Lebourveau and Taylor<sup>26</sup> found that vapors of ether, benzene, toluene, alcohol, and ethyl acetate can be recovered from mixtures with air by absorption in acetone oil or aniline followed by distillation and condensation.

*Carboxylic Acids.*—Vapors of solvents can be recovered from mixtures with gases by

<sup>24</sup> I. G. Farbenind. A.-G., Fr. 652,406, April 10, 1928.

<sup>25</sup> W. Pungs and K. Eisemann (to I. G. Farbenind. A.-G.) U. S. 1,839,702, Jan. 5, 1932.

<sup>25a</sup> H. J. Hibshman and R. H. Lafferty, U. S. 2,520,006 (Aug. 1950).

<sup>26</sup> U. J. Lebourveau and A. M. Taylor, U. S. 1,355,401 and 1,355,402, Oct. 12, 1920.

<sup>20</sup> R. Blockmann, *Chem.-Ztg.* **49**, 835 (1925).

<sup>21</sup> Bregéat-Aktiengesellschaft, *Chem.-Ztg.* **51**, 101 (1927).

<sup>22</sup> A. Hock, *Trans. Inst. Chem. Eng.* **7**, 118 (1929).

<sup>23</sup> Société des Etablissements Barbet, Fr. 847, 426, Oct. 10, 1939.

using as absorbers organic esters of carboxylic acid<sup>27</sup> having boiling points over 200° C. Suitable carboxylic acids are adipic, benzoic, phthalic acids, and similar acids.

*Phosphoric Acid Esters.*—Vaporized solvents can be recovered from mixtures with gases by passing them through an alkyl ester of phosphoric acid,<sup>28</sup> or else through an ester

<sup>27</sup> Deutsche Hydrierwerke A.-G., Ger. 487,515, Feb. 22, 1925.

<sup>28</sup> Celluloid Corp. Brit. 466,910, June 8, 1937.

of phosphoric acid containing at least one aliphatic alcohol radical and also at least one aliphatic phenol radical. Typical compounds are dibutylphenyl phosphate, methyl phosphate, propyl phosphate, ethyl phosphate, phosphoric acid esters of glycol ethers, etc. If the esters are solids under ordinary conditions, they can be dissolved in such solvents as diethyl phthalate, dibutyl tartrate, triacetin, or *o*- or *m*-tolueneethylsulfonamide.

## Chapter VIII

# SOLVENT RECOVERY BY ADSORPTION

### ADSORPTION

**Adsorption Equilibrium.**—When a gas or a vaporized liquid is brought into contact with a solid, there is a tendency for the formation of a solution of the gas or vapor in the solid as well as a tendency for the vapors to collect on the surface of the solid. Although the first tendency is usually very slight because of the low solubility of vapors and gases in most solids, the second tendency of adsorbing vapors and gases at the surface is exceedingly high for a number of solids. This power of adsorption which is shared by such solids as activated charcoal, coke, carbon black, silica gel, alumina (activated by treating with superheated steam at high temperatures) ferric hydroxide gel, soda lime, etc., is probably due to: (1) the formation of a monomolecular layer of the adsorbed vapor on the surface of the adsorbent, (2) the formation of another layer varying in thickness and kept there because of attractive forces between the solid adsorbent and the vapor or gas, and (3) to the collection of the partially condensed vapor or gas in extremely minute capillary openings on the surface of the adsorbent.

Although these three probable causes of adsorption apply to all solid adsorbents, they apply to different extents to these substances. Thus the adsorptive power of activated charcoal is due mainly to molecular attraction, that of ferric hydroxide gel is attributable both to molecular attraction and capillary condensation, while that of silica gel is due mainly to

capillary condensation. It should be noted, however, that the adsorptive power of any solid adsorbent may vary appreciably with the method of preparation as well as the nature of gas or vapor adsorbed. It should be noted also that mere porosity is not an indication of adsorptive power. Thus punice is not a good adsorbent for vapors or gases.

The extent of adsorption by solids is influenced also by the extent of exposed surface, the pressure, and the temperature. While adsorption can be defined as the tendency of *all* solids to condense and retain on their surface a layer of gas or liquid it should be remembered that this phenomenon is selective or specific. Adsorption is considered to be positive or negative depending on whether the adsorbed substance increases or decreases in concentration in the vicinity of the boundary.

*Freundlich Isotherm.*—After a process of adsorption has started, it will continue to occur until a state of adsorption equilibrium has been reached resulting in the adsorption of a definite amount by the solid adsorbent. Several empirical relationships have been devised for such adsorption phenomena under conditions of equilibrium.

Such a typical equation is Freundlich's adsorption isotherm

$$\left(\frac{x}{m}\right)^n = kc$$

In this equation  $x$  represents the weight adsorbed by weight  $m$  of the solid adsorbent from a solution with a volume concentration  $c$  at equilibrium while  $k$  and  $n$  are constants.

*Langmuir Equation.*—Another relationship is Langmuir's monomolecular formula<sup>1</sup> in which the assumption is made that the adsorbed vapor forms a monomolecular layer on the surface of the adsorbent solid and that adsorption comprises the chemical union of the elementary spaces of the adsorbing surface with the molecules of the adjacent gas depending upon the specific forces concerned, the relative sizes of the adsorbed molecules and the elementary spaces, and the orientation of the adsorbed gas molecules. This monomolecular formula can be stated as follows:

$$\frac{x}{m} = \frac{abp}{1 + ap}$$

In this equation  $x$  represents the weight adsorbed by  $m$  units of the adsorbent by weight,  $p$  is the partial pressure of the vapor or gas, and  $a$  and  $b$  are constants. Both the Freundlich adsorption isotherm and Langmuir's monomolecular formula give curves of about the same general curvature.

*Patrick Formula.*—Studies made by Patrick<sup>2</sup> and others on the amount of vapor adsorbed and the partial pressure for silica gel type adsorbents show that the following modification of the Freundlich adsorption isotherm applies accurately to the special case

$$V = K \left( \frac{P\sigma}{p} \right)^{1/n}$$

of adsorption by silica gel. In this equation  $V$  represents the volume of condensed vapor as measured as liquid per unit weight of the adsorbent,  $p$  represents the partial pressure of adsorbed vapor in equilibrium with the solid,  $P$  and  $\sigma$  denote the vapor pressure and the surface tension respectively of the liquid at the prevailing temperature, while  $K$  and  $n$  represent constants which depend entirely on the physical properties of the solid. This

Patrick adsorption equation can be expressed logarithmically as follows:

$$\log V = \log K + \frac{1}{n} \log \frac{p\sigma}{P}$$

This is a straight line equation and may be used, if  $K$  and  $\frac{1}{n}$  are known for an adsorbent of the silica gel type, to predict the volume of condensed gas or vapor that may be adsorbed by that adsorbent at definite conditions of temperature and pressure.

It was stated already that there is a very definite effect of temperature on adsorption; the amount adsorbed decreases very rapidly with an increase in temperature. This was shown by Gregg<sup>3</sup> for the case of the adsorption of ethylene by charcoal, and by Titoff<sup>4</sup> for the case of the adsorption of ammonia on charcoal.

*Adsorption and Temperature.*—*Heat Evolution.*—During the adsorption of vapors on the surface of solids a considerable amount of heat is evolved which is called the latent heat of adsorption or condensation. This heat is ordinarily given as calories per gram or British thermal units per pound and varies with such factors as the partial pressure of the gas or vapor in contact with the solid adsorbent as well as the amount already adsorbed by the solid. Approximate values for the differential heat of adsorption may be calculated by the Clapeyron equation. In the case of activated coconut charcoal the total heat of adsorption of various vapors adsorbed may be calculated according to Lamb and Coolidge<sup>5</sup> by means of the following equation

$$q = ax^b$$

in which  $q$  represents the calories evolved by  $x$  milliliters of the vapor adsorbed by one gram of the steam-activated coconut charcoal while  $a$  and  $b$  are constants. This heat of adsorption is a rather important factor which

<sup>1</sup> I. Langmuir, *J. Am. Chem. Soc.* **40**, 1361 (1918).

<sup>2</sup> W. A. Patrick, *J. Am. Chem. Soc.* **42**, 946 (1920).

<sup>3</sup> S. J. Gregg, *The Adsorption of Gases by Solids*. Methuen, London, 1934.

<sup>4</sup> A. Titoff, *Z. physik. Chem.* **74**, 641 (1910).

<sup>5</sup> A. B. Lamb and A. S. Coolidge, *J. Am. Chem. Soc.* **42**, 1146 (1920).

must not be neglected; if this heat is not removed, it will bring about an increase in the temperature of the adsorbing solid and will consequently reduce its adsorbing power.

**Adsorption of Mixtures.**—The adsorption phenomenon becomes somewhat more complex if the gas or vapor to be adsorbed consists not of one but of a mixture of substances. The adsorption of the various components in such a mixture is not uniform and, generally speaking, these components are adsorbed in approximately inverse relationship to their relative volatilities. For example, the vapor adsorbed by a solid adsorbent from a mixture of a very volatile and an appreciably less volatile ingredient will be richer in the less volatile substance than is present in the original mixture. This was shown by Miller<sup>6</sup> in his studies of the adsorption of mixtures of sulfur dioxide and air as well as other vapors by silica gel.

**Selective Action.**—Another factor in the adsorption of mixed vapors from gases is the selective action of the solid adsorbent. As more and more is adsorbed and as the solid becomes nearly saturated, the more volatile ingredient already adsorbed begins to re-evaporate while the less volatile ingredient continues to condense. Hence, at equilibrium conditions the adsorbent will have adsorbed mainly the less volatile ingredient and very little of the more volatile substance. The importance of this factor was shown by Burrell<sup>7</sup> and others in their study of the adsorption of mixed gasoline vapors from natural gas by activated charcoal.

**Rate of Adsorption.**—An important factor in solvent recovery by adsorption is the rate at which adsorption takes place. This rate varies with the difference between the partial pressure of the uncondensed vapor in the gas in contact with the adsorbing solid and the partial pressure of the vapor already condensed on the surface of the solid. This

adsorption rate is at first very high, decreases with increasing amount adsorbed, and finally stops at the saturation point when the vapor pressure has become equal to the partial pressure. Mathematical studies of such relationships and the principles of countercurrent extraction are discussed in detail by Lewis.<sup>8</sup> Many studies are described in the literature dealing with studies of the rate of adsorption for various substances. Such studies were made by Lamb and others.<sup>9-12</sup> The following empirical equations were derived by Bohart and Adams<sup>13</sup> for the rate at which a solid decreases in adsorption capacity:

$$\frac{\delta a}{\delta \theta} = -kac$$

and for the rate at which a gas loses vapor

$$\frac{\delta c}{\delta x} = \frac{-k}{v} ac$$

In these equations  $c$  represents the concentration of the vapor adsorbed at any point during its passage through the solid,  $x$  represents the distance through which it has passed,  $a$  is the residual vapor capacity of the solid at any time, and  $v$  denotes the rate flow of vapor per hour and is expressed as volume of solid saturated per hour if completely saturated. If in a batch adsorption process vapor and solid are brought together at constant temperature, then according to Baugham<sup>14</sup> and others the following formula is applicable:

$$\log \frac{x_s}{x_s - x} = k\theta^{1/n}$$

$x$  and  $x_s$  are the weights of vapor adsorbed in the time  $\theta$  and the time infinite respec-

<sup>8</sup> W. K. Lewis, *J. Ind. Eng. Chem.* **8**, 825 (1916).

<sup>9</sup> A. B. Lamb, R. E. Wilson, and N. K. Chaney, *Ind. Eng. Chem.* **11**, 420 (1919).

<sup>10</sup> H. S. Harned, *J. Am. Chem. Soc.* **42**, 372 (1920).

<sup>11</sup> E. B. Miller, *Chem. & Met. Eng.* **23**, 1155, 1219 (1920).

<sup>12</sup> G. A. Burrell, *Chem. & Met. Eng.* **24**, 156 (1921).

<sup>13</sup> G. S. Bohart and E. Q. Adams, *J. Am. Chem. Soc.* **42**, 528 (1920).

<sup>14</sup> Baugham, *Proc. Roy. Soc. London* **105A**, 981 (1924).

<sup>6</sup> E. B. Miller, *Chem. & Met. Eng.* **23**, 1155, 1219 (1920).

<sup>7</sup> G. A. Burrell, *Chem. & Met. Eng.* **24**, 156 (1921).

tively and in which  $k$  and  $n$  are constants. This constant  $k$ , according to Francis and Burt,<sup>15</sup> increases with temperature and doubles approximately for every 20° rise in temperature. Because of the rapid decrease of  $x_s$  with increasing temperature, it is best to carry out adsorptions at temperatures as low as possible.

**Recovery Methods.**—Solvent recovery by adsorption involves at least two steps, viz., (1) the adsorption of the solvent by the solid and (2) the extraction of the condensed solvent from the adsorbent. The latter operation may be carried out by revaporization at elevated temperatures or by treating the adsorbent with a permanent gas or an easily condensable vapor as steam. Revaporization may be brought about by heating the adsorbent in the absence of interfering gas to a temperature at which the vapor pressure of the adsorbed vapor is equal to that of the external pressure. While it is possible to carry out re-evaporation by this method very high temperatures are required in many cases to bring about complete re-evaporization by this means. Such reversibility of the adsorption of air-free sulfur dioxide by silica gel was investigated by Patrick;<sup>16</sup> in the presence of other gases a hysteresis effect occurs which renders the recovery irreversible. This extraction of the condensed vapor from the solid adsorbent may be aided as already stated by means of a so-called permanent gas (air, carbon dioxide, etc.) or a readily condensable vapor, e.g., steam.

A comprehensive review of the literature dealing with processes of (1) adsorption of gases and vaporized liquids, (2) adsorption of substances from liquids, and (3) drying of gases and liquids is presented by Ray.<sup>17</sup> A bibliographical survey of published information dealing with various solid adsorbents and covering the years 1900–1942 is given

by Dietz.<sup>18</sup> A correlation of practical, commercial, and engineering aspects of the phenomenon of adsorption by different adsorbents in various fields is made by Mantell.<sup>18a</sup>

**Activated Carbon.**—Of the various substances which have been used as adsorbents such as activated carbon, Fuller's earth, activated bauxite, activated clays, silica gel, etc., for solvent recovery by adsorption, activated carbon has found wide acceptance in this country. Ray<sup>17</sup> states as follows: "The use of activated carbon for the recovery of solvents vaporized in manufacturing operations originated in Germany about thirty years ago. Many improvements in carbons, processes, and equipment have been made until now the various activated carbon processes are used the world over to recover billions of pounds of solvents per year. In North America alone, carbon recovery plants installed or being built have a recovery capacity of over one billion pounds of solvents per year. The leading European and American processes differ in types of carbons and equipment used and in operating procedure but, in general, they all have the ability to recover solvent vapors present in low concentration in air or other gases. Improvements in carbon, in adsorber design, and in operating procedure have increased recovery efficiency and reduced recovery expense. Most of the recovery plants installed in North America during recent years are automatically operated which makes possible the safe and efficient operation of very large plants." Adsorption studies of vapors in towers packed with carbon were studied by Engle and Coull.<sup>18b</sup>

In order to be efficient in the industrial adsorption of gases and vapors Ray<sup>19</sup> showed that activated charcoal must possess high

<sup>15</sup> M. Francis and F. P. Burt, *Proc. Roy. Soc. London*, **116A**, 586 (1927).

<sup>16</sup> W. A. Patrick, *J. Am. Chem. Soc.* **42**, 963 (1920).

<sup>17</sup> A. B. Ray, *Ind. Eng. Chem.* **39**, 12 (1947).

<sup>18</sup> V. R. Dietz, *Bibliography of Solid Adsorbents*, U. S. Cane Sugar Refiners and Bone Char Manufacturers and National Bureau of Standards, 1944.

<sup>18a</sup> C. L. Mantell, *Adsorption*. McGraw-Hill, New York, 1945.

<sup>18b</sup> H. C. Engle and J. Coull, *Trans. Am. Inst. Chem. Engrs.* **38**, 947 (1942).

<sup>19</sup> A. B. Ray, *Chem. & Met. Eng.* **29**, 354 (1923).

mechanical strength as well as a relatively high apparent density. Activated charcoal has specific attraction for many solvent vapors; thus when it is wet with water it will still remove gasoline from natural gas. On the other hand, silica gel has a specific attraction for water vapors and will adsorb solvent vapors only when it is very dry.

The adsorption process of solvent recovery by means of a solid adsorbent, such as activated charcoal, is well suited for the recovery of volatile inflammable solvents from gaseous mixtures.<sup>20</sup>

Sometimes the activated charcoal is subjected to a pretreatment previous to its use as an adsorbent for solvent vapors. Thus to render charcoal of vegetable origin especially suitable for the adsorption of solvents such as ethyl acetate, it is first submerged in water containing enough acetic acid to neutralize the charcoal, freed from the wash liquid, and then washed for about six hours with approximately 20 times its weight of tap water acidified to a pH of 5-6 with acetic acid.<sup>21</sup>

Industrial applications of the adsorption properties of activated charcoal for solvent recovery processes are reviewed by Chapuis<sup>21a</sup> who presents several examples from actual practice to show the large variety of solvent recovery problems which may be handled by means of activated charcoal.

Anglehardt<sup>22</sup> showed that one kilogram of activated charcoal may adsorb as much as 200 grams of ether from a current of gas. The adsorbed vapor may be removed later from the charcoal either by steam or a vacuum.

Berl and Andress<sup>23</sup> found that vapors of organic compounds of high molecular weight and high boiling point can be recovered advantageously from mixtures with air and water vapor by means of activated charcoal

and that the latter is inert toward water vapor in releasing and adsorbing water vapor. The frequent use of charcoal lowers its adsorption value.

Griffiths<sup>24</sup> points out that the outstanding feature of the activated carbon adsorption process is the fact that it makes possible high efficiency solvent recovery from air or gas containing only low concentrations of the solvent. The operating cost of the modern solvent recovery process using activated carbon is practically independent of the solvent concentration and is nearly in linear proportion to the amount of solvent recovered.

Gas adsorption methods for measuring the surface area of adsorbents were investigated by Emmett,<sup>25</sup> and a variety of studies dealing with solvent recoveries by different solids were described by Alekseevskii<sup>26</sup> and others.

A commercial unit suitable for the recovery of solvents by adsorption must contain (1) a solid adsorber enclosed in some kind of container, (2) a means of removing the condensed solvent from the solid adsorbent by means of heated vapor or gas, and (3) a condenser for recovering the solvent vaporized from the adsorbent. Although all recovery systems of this type must consist of three essential parts just mentioned, they may vary widely in details of design, depending upon the nature of the solid adsorbent and the solvent, the materials of construction, accessories, etc. It would be beyond the scope of this text to discuss all the various units described in the literature in detail.

An apparatus suitable for studying the adsorbing properties of activated charcoal and other adsorbents for solvent vapors was developed by Reiner.<sup>27</sup> This apparatus is H-shaped and vacuum tight. The two vertical vessels serve as receivers for the bottles filled with solvent and adsorbent respectively, and means are provided for removing and replacing stoppers without opening the apparatus.

<sup>24</sup> H. Griffiths, *Chem. Trade J.* **96**, 235 (1936).

<sup>25</sup> P. H. Emmett, *Ind. Eng. Chem.* **37**, 639 (1945).

<sup>26</sup> E. V. Alekseevskii *et al.*, *J. Applied Chem.* (U.S.S.R.) **17**, 487 (1944).

<sup>27</sup> S. Reiner, *Chem.-Ztg.* **55**, 203 (1931).

<sup>20</sup> A. B. Ray and L. A. Logan (to Carbide & Carbon Chemicals Corp.), U. S. 2,211,162, Aug. 13, 1940.

<sup>21</sup> G. W. Brant (to E. I. du Pont de Nemours & Co., Inc.) U. S. 2,177,473, Oct. 24, 1939.

<sup>21a</sup> A. Chapuis, *Chimie & industrie* **52**, 52 (1944).

<sup>22</sup> A. Anglehardt, *Kunststoffe* **10**, 194 (1920).

<sup>23</sup> E. Berl and K. Andress, *Z. angew. Chem.* **34**, Aufsatzteil, 369, 377 (1921).

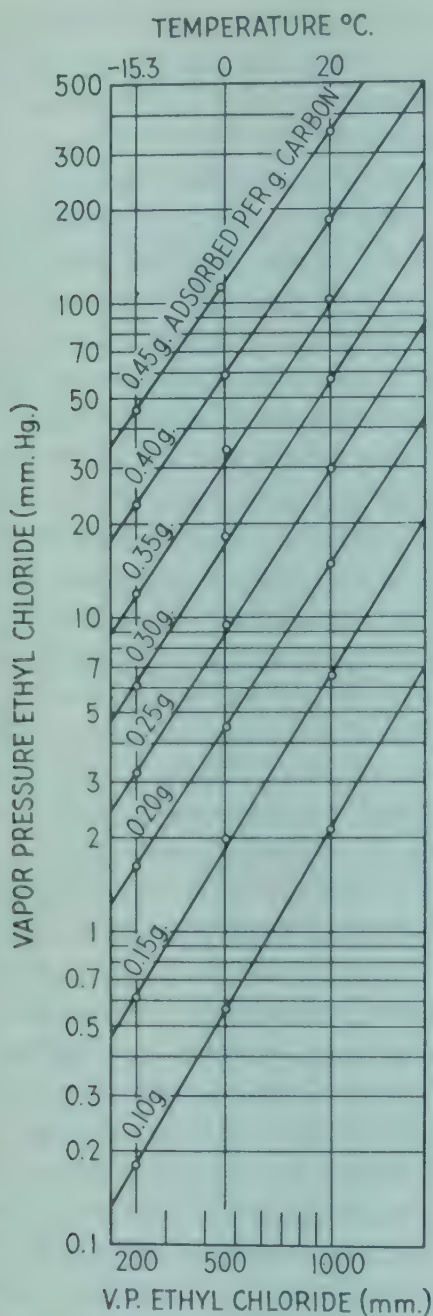


FIG. 11. Isosteres of Ethyl Chloride Adsorbed on Charcoal

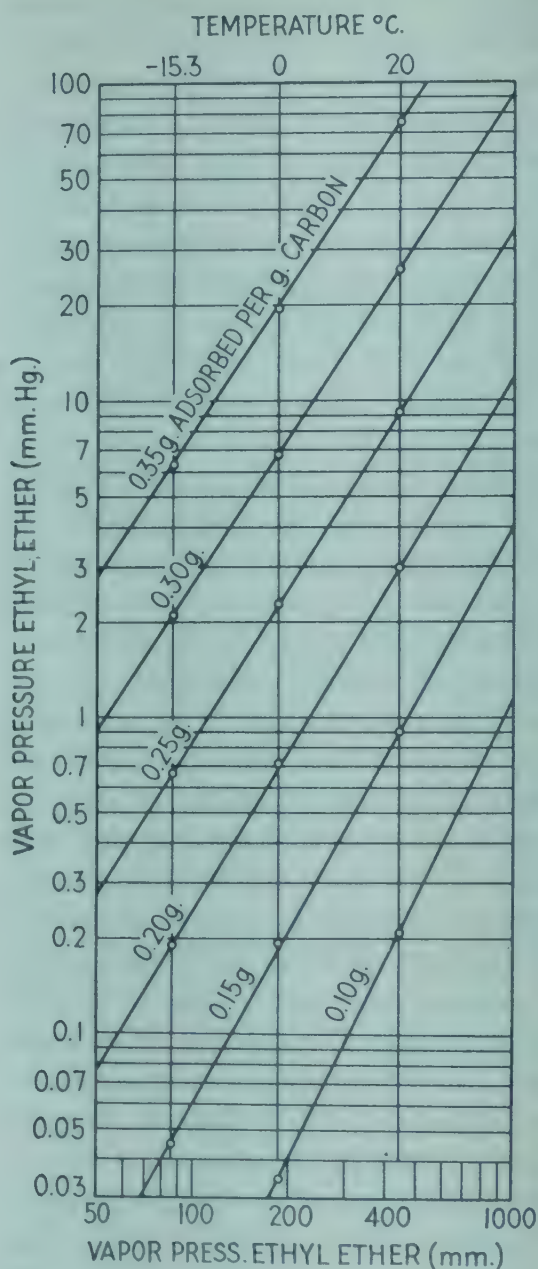


FIG. 12. Isosteres of Ethyl Ether Adsorbed on Charcoal

*Adsorption Equilibria.*—Othmer and Sawyer<sup>28</sup> presented a correlation of adsorption data dealing with equilibrium vapor pressures of gas or vapor adsorbed on activated carbon as related to concentrations of gas or vapor by means of a graphical method (Figs. 11 and 12). The equilibrium vapor pressures of an adsorbate out of a solid adsorbent were plotted against the normal vapor pressures

<sup>28</sup> D. F. Othmer and F. G. Sawyer, *Ind. Eng. Chem.* **35**, 1269 (1943).

of the same or a different material at corresponding temperatures giving isosteres (straight lines) on a logarithmic plot. In another study the latter investigators<sup>29</sup> determined the adsorption equilibria of pressures, temperatures, and concentrations for these solvents (Figs. 13, 14) on a commercial grade of activated carbon: acetone, ethyl methyl ketone, isobutyl methyl ketone, methanol, car-

<sup>29</sup> F. G. Sawyer and D. F. Othmer, *Ind. Eng. Chem.* **36**, 894 (1944).

bon disulfide, and ethyl ether. The apparatus used in this study permitted the rapid measurement of the equilibrium adsorbate concentration over a wide range of vapor pressure and adsorbent temperatures and was of the static weight type; the type of vapor ad-

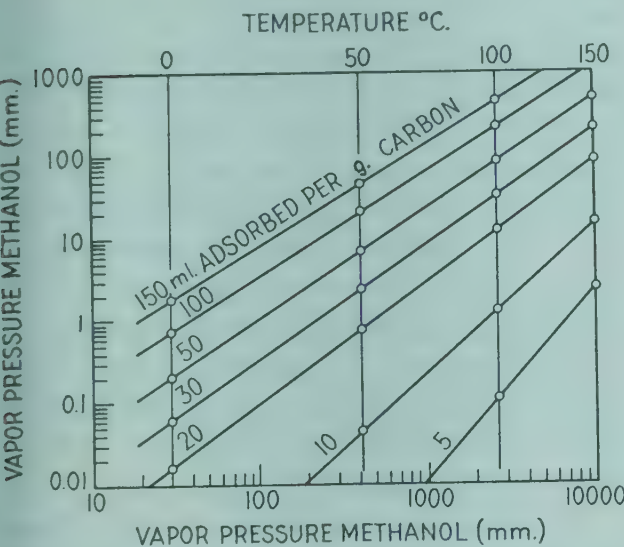


FIG. 13. Isosteres of Methanol Adsorbed on Charcoal, Showing the Abrupt Change in Slope of Isosteres at Low Adsorbate Concentration

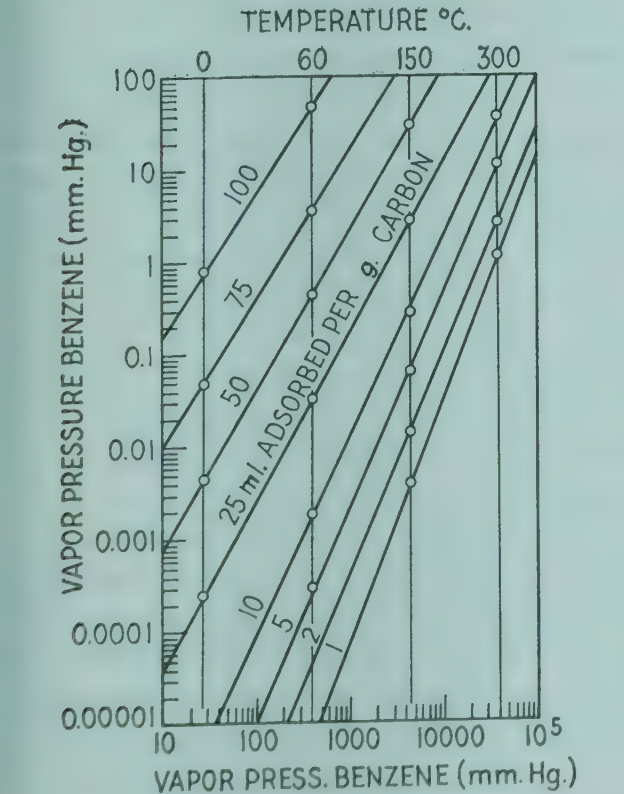


FIG. 14. Isosteres of Benzene Adsorbed on Charcoal between 0° and 300° C.

sorbed was measured by observing with a microscope the elongation of a beryllium-copper spring carrying the adsorbent. Typical isotherms of acetone adsorption found in the study by Sawyer and Othmer are shown in Fig. 15.

The adsorption of solvent vapors by a specially prepared, acid-washed, ash-free, steam-activated charcoal at various temperatures up to and above their critical temperatures was studied by Pearce and Knudson.<sup>30</sup> They determined adsorption isotherms for vapors of ethyl and methyl alcohols, water,

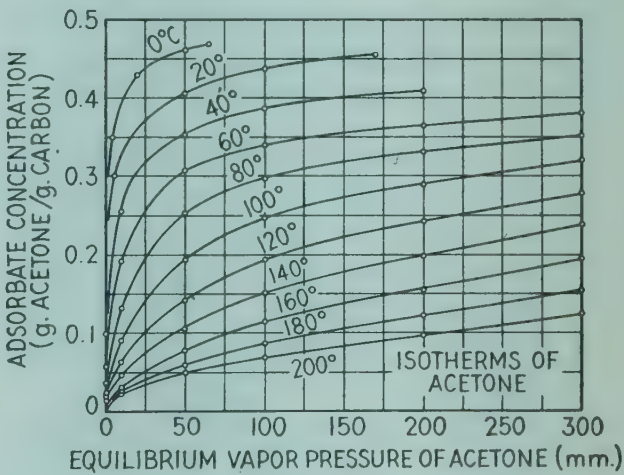


FIG. 15. Isotherms of Acetone Adsorption

ammonia, and methylamine. The isotherms for water show that they are different from the isotherms of the other vapors, that the phenomenon is different in the case of water, and that water vapors are retained by mere capillary action instead of surface forces of adsorption. The Freundlich isotherm applies except near saturation to ammonia and to the two alcohols but neither to water nor to methylamine. The Freundlich isostere equation applies fairly accurately for the special case where  $\xi = 0$  at all except high temperatures. The law of corresponding states holds approximately for the alcohols and for ammonia.

The physicochemical properties of mixtures obtained in the recovery of organic

<sup>30</sup> J. N. Pearce and C. M. Knudson, *Proc. Iowa Acad. Sci.* **34**, 197 (1927).

solvents by the use of activated carbon was investigated by Ruderman<sup>31</sup> who, using a miscibility triangle, calculated the amounts of upper and of lower liquid layers procured from a ternary liquid mixture of a definite composition.

*Columbia Activated Carbon System.*—Among the types of commonly employed organic solvents which can be recovered by the use of activated carbons are alcohols, chlorinated hydrocarbons, esters, ethers, hydrocarbons, ketones, sulfur compounds, etc. Eight outstanding advantages of the use of an activated carbon system of the Carbide and Carbon Chemicals Corporation are listed in the booklet *Solvent Recovery* by the Columbia Activated Carbon System:<sup>32</sup>

1. Recovers all types of volatile solvents.
2. Plant designed to recover one solvent or mixture can usually be used to recover another solvent with only minor changes.
3. Recovers solvent vapors in low concentration.
4. Recovers solvents efficiently in presence of water vapor.
5. Recovers solvent vapors with high overall efficiency.
6. Recovery plant may be completely automatic in operation.
7. Recovery plant investment moderate.
8. Recovery expense low.

In one type of this solvent recovery system the atmosphere laden with the solvent to be recovered is drawn into the solvent-collecting system by means of a blower and is then passed through the layer of activated carbon. While passing through this bed of adsorbent, the vaporized solvent is removed from the atmosphere by adsorption in the activated carbon while the air freed from the vapor is discharged. Ordinarily there are at least two beds of activated carbon. As the

layer of carbon in one bed becomes saturated with or has adsorbed the required quantity of solvent, which process may take 30–60 minutes, the nonprocessed vapor-laden air is passed through another adsorbing bed of activated carbon.

In order to regenerate the solvent adsorbing properties of the first bed of activated carbon, it is necessary to pass low-pressure steam through the bed of activated carbon. The mixture of steam and vaporized solvent is then condensed. The method used for separating the condensed liquid solvent from the water condensed from the steam-solvent vapor mixture depends on whether or not the solvent is insoluble or soluble in water; if it is insoluble, then it can be separated readily by means of an automatic decanter; however, if it is soluble, then it is separated from the water by distillation.

Flow diagrams of solvent recovery plants operated without and with cooling periods are shown in Figs. 16 and 17.

*Carbo-Union System.*—The Carbo-Union (Bayer) solvent recovery apparatus is described in detail by Liddle,<sup>33</sup> Evans<sup>34</sup> and others. A typical schematic arrangement of the Carbo-Union (Bayer) active carbon process is shown. The requirements of such a plant are approximately 3 kg. of steam, 40 kg. of water, and 0.2 kw.-hr. of current per kg. of solvent for operation with steam economizer and with a minimum of loss. The carbon consumption is 1 kg. per ton of recovered solvent and is greater with gases containing sulfur. The economizer is an evaporator and works on the ejector-vacuum principle.

Differences between the European Bayer and the Metallbank processes are discussed by Ditmar<sup>35</sup> who pointed out that the latter differs from the former by minimizing the heat loss through utilization of the counter-current principle. The air-vapor mixture is

<sup>31</sup> L. Ya. Ruderman, *J. Applied Chem.* (U.S.S.R.) **20**, 908 (1947).

<sup>32</sup> Carbide and Carbon Chemicals Corporation, Unit of Union Carbide and Carbon Corporation, New York 17, N. Y.

<sup>33</sup> J. C. Liddle, *Chem. Age* **26**, 87 (1932).

<sup>34</sup> K. Evans, H. F. Pearson, and E. Reisemann, *Trans. Inst. Chem. Engrs.* **7**, 134 (1929).

<sup>35</sup> R. Ditmar, *Caoutchouc & Gutta-percha* **22**, 12,810 (1925).

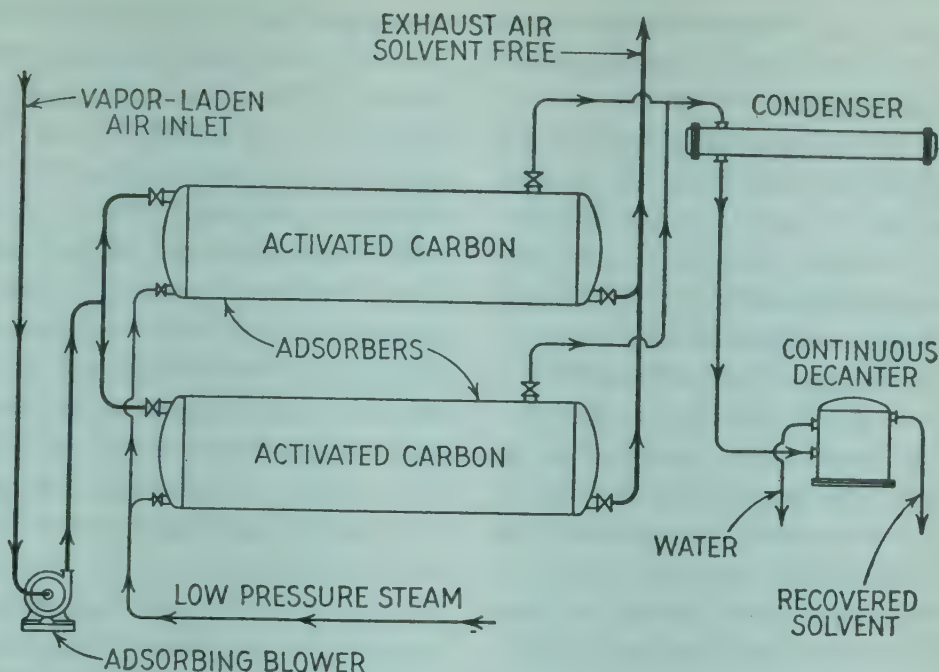


FIG. 16. Flow Diagram of Recovery Plant Operated Without Cooling Cycle<sup>a</sup>

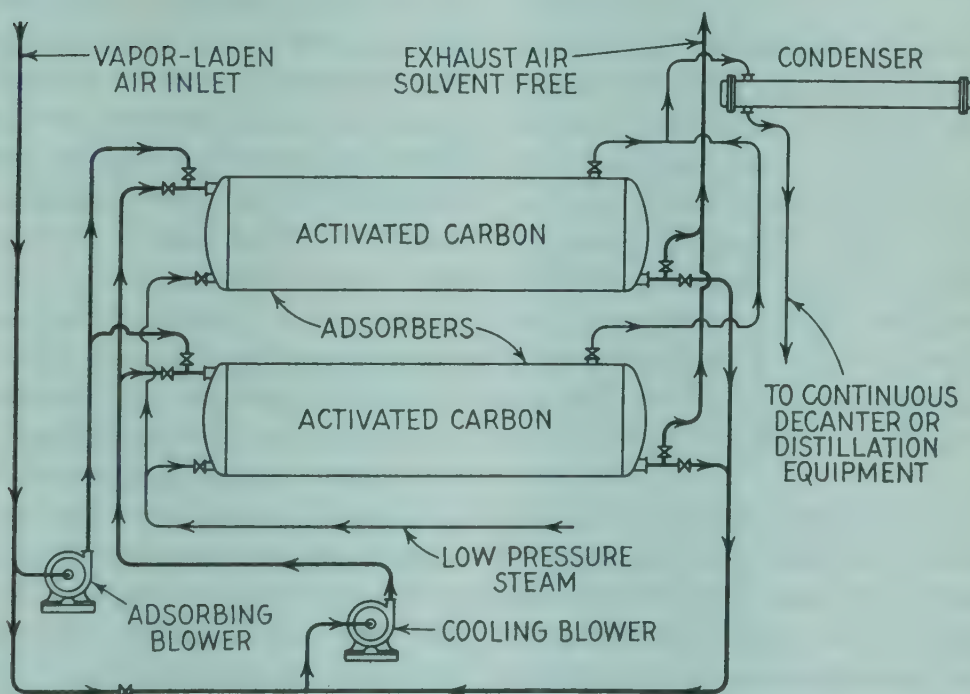


FIG. 17. Flow Chart of Solvent Recovery Plant Operated with Cooling Period<sup>a</sup>

<sup>a</sup> After *Solvent Recovery by the Columbia Activated Carbon System*. Carbide and Carbon Chemicals Corporation, New York, 1943.

passed through a layer of activated charcoal which descends gradually through a constriction into another chamber below. This chamber is composed of tubes heated on the outside by gas through which the saturated charcoal passes and from which the vapor

is discharged. Inert gas is introduced at the top and the bottom of the recovery system, sweeps through the charcoal, and is discharged at the center section into a condenser which recovers the vapor. The charcoal freed from vapor passes into a cooling chamber

below, from which it returns to the top of the system, thus resuming again its downward passage through the system.

*Other Processes.*—In order to recover solvents of low solubility in water, e.g., carbon disulfide, alcohol, benzene, ethers, esters, paraffinic or aromatic hydrocarbons, etc., from gaseous mixtures containing impurities such as hydrogen sulfide, arsine, etc., the mixtures are freed from these troublesome impurities prior to the adsorption by bringing them into contact with activated charcoal highly charged with water.<sup>36</sup> In this initial purification the charcoal is regenerated at regular intervals by washing with dilute sodium carbonate, superheated steam, or some other suitable treatment. If necessary, this initial treatment with water-charged activated charcoal is preceded by a preliminary washing with water to remove some of the impurities.

Tod<sup>37</sup> combined an apparatus for the recovery of volatile solvents from the atmosphere by passage through a solid adsorbent with a heat exchanger which had been provided with means for heating and cooling. This heat exchanger (1) cools the solvent-laden air to be passed through the apparatus, (2) condenses the mixture of solvent vapor and steam obtained during the regeneration of the adsorbent, and (3) warms the gas passed through the regenerated adsorbent to dry it.

Zucker<sup>38</sup> uses adsorber cartridges for solvent recovery; these cartridges are inserted into an adsorber shell, are removed after saturation, and are then replaced with others. In order to render the saturated cartridges ready for re-use, they are put into desorber units provided with vaporizer, condenser, and one or more recipients. In these desorber units, the solvent is separated from the cartridges by steam, and any residual moisture is forced out by hot air.

**Separation of Adsorbed Solvents.**—Ray<sup>39</sup> showed that in the recovery of liquid solvents which are only slightly soluble in water, such as esters, ethers, or hydrocarbons, the mixture of vapors is passed over activated charcoal, which is later treated with steam to distill the adsorbed solvent. After the latter has been removed from the adsorbent, the distillate is condensed, forming two liquids which contain different concentrations of the liquid to be recovered. The liquid of lower concentration is then brought into contact with activated charcoal to cool the charcoal and collect in it the substance to be recovered.

*Steam.*—The separation of adsorbed compounds from bodies of large surfaces is discussed by Berl and Schwebel.<sup>40</sup> The ordinary method is to pass superheated steam through the adsorbent and to condense the evolved vapor. The separation may be accomplished by (1) combination of external heating and of superheated steam at various pressures, (2) steam alone without external heating, and (3) external heating at different pressures. They found that the best technical procedure is a combination of external heating and steam under vacuum.

Bollmann<sup>41</sup> freed volatile solvents from solids by passing the solids on a screen conveyor in a countercurrent direction to a flow of steam on an inclined passageway and alternately heating and cooling the section.

In another apparatus<sup>42</sup> for the recovery of solvents from the air, the air is passed through a suitable solid adsorbent like charcoal and the solvent afterwards recovered by passing steam through the adsorber. This apparatus consists of a chamber with a perforated false bottom on which the adsorbent is located, a perforated false top, a roof which separates the first chamber from another one provided with dirt-extracting filters through which

<sup>39</sup> A. B. Ray, U. S. 1,604,481, Oct. 26, 1926.

<sup>36</sup> Carbonisation et Charbons Actifs, Fr. 829,650, July 1, 1938; Brit. 488,316, July 5, 1938.

<sup>37</sup> A. H. Tod, Brit. 495,656, Nov. 17, 1938.

<sup>38</sup> J. Zucker, Swiss 216,683, Sept. 15, 1941.

<sup>40</sup> E. Berl and W. Schwebel, *Z. angew. Chem.* **36**, 541, 552 (1923).

<sup>41</sup> H. Bollmann, Brit. 153,044; Oct. 21, 1919.

<sup>42</sup> W. M. Still & Sons and E. H. Still, Brit. 501,781, March 6, 1939.

the air is forced, as well as suitable valves for the air and inlets and outlets for the steam.

Deringer<sup>43</sup> also suggests the use of activated charcoal for the recovery of benzene and other solvents in gasworks and coke ovens. In this process an inert gas containing none or almost no air, e.g., coal gas or internal combustion engine exhaust gas, is employed to remove the solvent vapors adsorbed by the activated charcoal. Indirect steam is used to heat the adsorber as well as the gas during the solvent recovery operation. The average steam requirements for the process (without recovery of the heat liberated during light oil condensation) are approximately 2.2 kilograms per kilogram of light oil, which amount is about half the steam requirements for the direct steam process.

**Carbon Dioxide.**—After substances such as chlorinated acetylene derivatives, ethers, hydrocarbons, ketones, etc., have been adsorbed from air by means of activated charcoal or silica gel, they can be removed<sup>44</sup> from the solid adsorbent by displacement with heated carbon dioxide; the saturated carbon dioxide is then passed through a solution of potassium hydroxide.

**Incondensable Gas.**—Coggeshall and Rector<sup>45</sup> removed condensable volatile solvents, e.g., alcohol, which had been adsorbed by some adsorbent by heating in a current of incondensable gas and circulating the latter cyclically through the adsorber and a condenser.

**Silica Gel.**—The adsorption of vapors by silica gel was studied by Miller<sup>46</sup> who found that the factors influencing adsorption are (1) the corresponding pressure, i.e., the ratio of the pressure of the vapor in equilibrium

with the adsorbent to the vapor pressure of the liquid and the adsorption temperature, and (2) the compressibility of the adsorbed liquid. The adsorbent must have a very large internal volume consisting of spaces of minimum dimensions. This is true for silica gel of which one gram adsorbs 0.41 ml. of water. The extent of adsorption is increased by lowering the temperature or increasing the concentration. Because the adsorbing properties of silical gel depend not on any specific chemical action but on the physical properties of the vapor to be adsorbed, it is suitable for the recovery of solvent vapor from the air at ordinary atmospheric conditions as long as the boiling point of the liquid at atmospheric pressure exceeds  $-10^{\circ}$ . Miller showed furthermore that the adsorbed vapor can be withdrawn from the adsorbent by (a) raising the temperature and (b) decreasing the partial pressure of the vapor over the gel by evacuation or displacement.

Turk<sup>46a</sup> in comparing the adsorption properties of silica gel and activated carbon noted that the latter is nonpolar and since it has no affinity for water, will adsorb organic compounds in preference to water. Silica gel, on the other hand, is polar. It retains water and may reject an organic compound. It can also discriminate more selectively than activated carbon and consequently can be used for the fractionation of organic solvents.

Pick<sup>47</sup> patented the use of Raschig rings made from compressed silica gel for use in the recovery of volatile solvents.

Koopmann<sup>48</sup> showed that difficult solvent recovery problems may be solved by the use of silica gel. The complete cycle of operations involves three or four steps as follows:

1. Adsorption of solvent vapors up to the saturation of the gel.
2. Desorption of the adsorbed solvent by

<sup>43</sup> H. Deringer, *Trans. Fuel Economy Conf., World Power Conf., Sect. A4, Paper No. 4*, 7 pp. (1947).

<sup>44</sup> Verein für chemische Industrie, A.-G., Fr. 651,716, March 24, 1928.

<sup>45</sup> G. W. Coggeshall and T. M. Rector, U. S. 1,418,363; Jan. 6, 1922.

<sup>46</sup> E. B. Miller, *Chem. & Met. Eng.* **23**, 1155, 1219, 1251 (1920).

<sup>46a</sup> A. Turk, "Odorous Atmospheric Gases and Vapors" in Conference on Basic Odor Research Correlation, *N. Y. Acad. Sci., Annals*, 1953.

<sup>47</sup> M. Pick, Austrian 142,755, Sept. 10, 1935.

<sup>48</sup> A. Koopmann, *Kautschuk* **23**, 205 (1933).

treating the adsorbent with superheated steam.

3. Activation of the moist silica gel by means of hot air, and, if necessary—
4. Cooling of the hot silica gel with cold, dry air.

He points out the highly selective adsorbing properties of silica gel. Substances with higher boiling point are adsorbed more readily. Furthermore, a silica gel which is saturated with a solvent of low boiling point on treatment with another solvent of higher boiling point will discharge the former and will adsorb the solvent with the higher boiling point. A mixture of vapors of solvent of different boiling points is adsorbed by the silica gel at first in accordance with their relative concentrations. After saturation has been reached the vapors of the lower boiling solvent are replaced gradually by vapors of supplementary portions of the higher boiling solvent resulting in a gradual enrichment of the higher boiling component and finally in the complete adsorption of the latter to the exclusion of the low boiling compound.

An adsorbent which is especially suitable for the recovery of tribromomethane is "Blaugel," a combination of silica gel and a cobalt salt.<sup>49</sup> "Blaugel," on adsorbing water, turns from red to blue and adsorbs, at 20° C., 32.5% by weight of water and 23.8–72.2% by weight of organic solvents. The amount of adsorption depends on the density. The color change is not very distinct and varies considerably with different granules. The "Blaugel" may be regenerated by heating it to 180–200° C.

**Yamagata Clay.**—The adsorption of organic solvents by Yamagata clay was studied by Uchida.<sup>50</sup> This clay adsorbs water selectively and adsorbs various organic solvents only in small amounts. There is no relationship between the swelled volume and either the dipole moment or the dielectric constant of the solvent. The relative viscosity of the

system clay sol-water-ethyl alcohol becomes infinitely great near the maximum point of the water-alcohol system.

**Rubber.**—The possible use of rubber as an adsorptive agent for vapors of liquids was considered by Reiner<sup>51</sup> who determined the rate and extent of such vapor adsorption by rubber at room temperature. The rubber was purified by solution in benzene and precipitation with alcohol; afterwards it was finely divided to produce a large surface. Exposing this finely divided rubber to vapors of benzene at 25° C. for 700 hours showed a slow and progressive rate of adsorption which did not reach equilibrium even after 700 hours. At that time the rubber was sticky and swollen and still gave indication that the adsorption could have continued further progressively.

**Desorption.**—The mechanism of the process of desorption of solvent vapors of ethyl alcohol and ether and their mixtures from activated charcoal containing 4% water was studied by Okatov and Levina.<sup>52</sup> In the sorption of vaporized solvents the middle layers of the sorbent may increase in temperature by tens of degrees, thus becoming less active. This can be avoided by preliminary cooling of the vapors. This increase in temperature of the sorbent is due to sorption of vaporized water. The rate of the latter depends on the nature of the sorbent. The desorption of alcohol with water vapor was completed in 45 minutes while that of the ether in 60 minutes. The use of highly activated charcoals is not recommended for this application because of the excessive amount of steam needed for the desorption and because of the resulting highly diluted solvent solutions.

Alekseevskii<sup>53</sup> *et al.* made a detailed study

<sup>51</sup> S. Reiner, *Kautschuk* **4**, 210 (1928).

<sup>52</sup> A. P. Okatov and Z. I. Levina, *J. Applied Chem. (U.S.S.R.)* **9**, 287 (1936).

<sup>49</sup> K. Seiler, *Pharm. Acta Helv.* **14**, 125 (1939).

<sup>50</sup> M. Uchida, *J. Soc. Chem. Ind. Japan* **38**, Suppl. Binding 513 (1935).

<sup>53</sup> E. V. Alekseevskii and B. A. Vaskovskii, *J. Applied Chem. (U.S.S.R.)* **8**, 779 (1935); E. V. Alekseevskii and Z. I. Azark, *Ibid.* 802; E. V. Alekseevskii and G. M. Moskvina, *Ibid.* **9**, 1010 (1936); E. V. Alekseevskii and Ya. D. Musin, *Ibid.* **12**, 704 (1939); E. V. Alekseevskii and A. M. Mintel, *Ibid.* **13**, 1565 (1940); E. V. Alekseevskii

of the recovery of volatile solvents by solid sorbents. Data were presented for the static adsorption of carbon tetrachloride by charcoal and its desorption by steam, and for the sorption of carbon disulfide by charcoal and its desorption by alcohol or water vapors. Activated charcoal was shown to be preferable to silicon dioxide, ferric oxide, or aluminum oxide gels, and desorption by steam was found to be commercially possible. The formation of ethyl dioxides was not observed in the adsorption and desorption of an alcohol-ether mixture by granulated activated charcoal in the presence or absence of iron in a stream of oxygen or air. However, this carbon which was saturated with the vapors of this mixture sometimes yielded traces of ethyl dioxides after prolonged exposure to air. Adsorption isobars determined for various chlorine-containing organic solvents by granulated active carbon and adsorption isotherms for 20° C. showed that 1,2-dichloroethane and carbon tetrachloride gave the best results. Studies of the dynamics of adsorption and catalytic action of carbon on the decomposition of the chlorinated organic compounds showed that it is practical to recover these solvents by adsorption with activated charcoal and desorption with superheated steam. Ethyl acetate is saponified to a lesser extent in the presence of activated charcoal than in its absence; however, the use of charcoal which had been activated with zinc chloride increases the saponification appreciably. The use of birch charcoal activated with zinc chloride should be avoided since it retains the ester firmly. The ester can be desorbed readily from a special grade of granulated charcoal "A.G." by the use of steam at 110–120° C. Under dynamic sorption of vapors of alcohol and of benzene on activated charcoal in concentration of 15–30 mg. per liter in the working part of the packing, it was found that there was considerable heating of the packing which influenced the var-

ious factors which, in turn, influence the sorption. This effect was especially pronounced in the case of short layers of the sorbent. It is possible to use the temperature gradient along the layer of charcoal as a measure of the distribution of solvents concentration along the length of the packing. The desorption of ethyl alcohol and of benzene from charcoal AP by steam was found to occur simultaneously with water vapor sorption; the latter is a function of charcoal temperature, time, nature of displaced solvent as well as the retaining property of the activated charcoal. The greater the capacity of the activated charcoal for the solvent and the poorer the miscibility between this solvent and water, the less intense was found to be the sorption of water in this displacement. Ordinarily, 45–85% of the amount of adsorbed solvent is displaced during the first 10 minutes. During the sorption of vaporized water by charcoal AP at the desorption temperature of volatile solvents (100–103° C.) the temperature in the charcoal rose to 124°, with the amount of water adsorbed varying from a maximum in the first layer to a minimum in the last layer. The quantity of the water adsorbed under these conditions is smaller than that under identical conditions during the desorption of solvents from charcoal by water vapor, probably because of the lower temperature (110–112° C.) produced by the latter condition. The desorption rate of alcohol and benzene from charcoal by water vapor is related to the residual amount of solvent vapor by the relationship

$$\frac{-da}{-dt} = bu^n$$

In this relationship  $a$  represents the concentration of the solvent,  $t$  is the time,  $b$  and  $n$  denote experimental constants, and  $\frac{da}{dt}$  denotes the rate of sorption. Alcohol was found to be desorbed less rapidly than benzene. The quantity of desorbed vapor depends linearly on the depth of the layer of charcoal.

The desorption of solvents from activated

and N. D. Gorcha Kov, *Ibid.* 17, 289 (1944); E. V. Alekseevskii and S. S. Vanyushina, *Ibid.* 18, 193, 377, 658 (1945).

charcoal by means of inert gases was investigated by Gorchakov<sup>54</sup> *et al.* who tested charcoal AP statically. Thus the desorption of ethyl alcohol from this charcoal was investigated using carbon dioxide for desorbent at 95–98° C., 110–112° C., and 125–130° C.; the last temperature range was the optimum temperature condition at a carbon dioxide rate of 0.5 liters per square centimeter per minute. When carbon dioxide and nitrogen were studied under conditions of continuous use of the layer of charcoal, the optimum conditions were the same, and 91–92% of the alcohol was desorbed as 95–96% ethyl alcohol. As in this method the only amount of carbon dioxide actually needed is the quantity necessary to fill the apparatus; this method is superior to the steam desorption method. In the desorption of benzene by carbon dioxide, the dynamic activity of charcoal AP at a layer depth of 100 cm. and a benzene concentration of 30 mg. per liter was 20–30% and the optimum time for desorption was 15 minutes at 180° C., while the rate of carbon dioxide flow was 0.5 liter per square centimeters per minute. Under these conditions 72% of the benzene which was adsorbed on the charcoal could be condensed.

### DISTILLATION

It is beyond the scope of this book to discuss the distillation of solvents in any detail. A few comments relating to solvent recovery are pertinent.

The distillate obtainable from a solution naturally depends to a certain extent upon the composition and properties of the solution. This is particularly the case if the solution contains two or more volatile ingredients. If the solution represents a binary mixture of completely soluble liquids, then there are three distinct possibilities as follows: (1) The vapor produced is always

richer in the more volatile ingredient than the liquid mixture as for instance in mixtures of benzene and toluene, (2) the vapor produced is richer in this more volatile ingredient than the liquid mixture only up to a certain composition, the azeotropic mixture as for example in mixtures of alcohol and water, and (3) the molecular attraction of the different molecules of the binary mixture is greater than the attraction between the same kind of molecules. There are not many instances of solvent mixtures in this class but a solution of hydrogen chloride in water is an example. Here the attraction is so strong that there is no appreciable vapor pressure of hydrogen chloride present when the concentration is below the constant boiling mixture.

If the liquids in a given mixture are not completely soluble in one another, then the vapor produced remains the same in composition and the boiling point does not vary at constant pressure as long as all of these liquid ingredients remain in this mixture. This picture changes immediately as soon as one of the ingredients has distilled over completely.

Jean<sup>55</sup> recovers volatile solvents by distillation under vacuum, submitting the vapors to thermocompression by adding steam under pressure, and condensing the compressed vapors at a temperature above that at which they were distilled under vacuum.

A distillation system for the recovery of volatile substances from solvents of high boiling point was developed by Schmalenbach.<sup>56</sup> In a continuous distillation process involving indirect heating the mixture is first preheated. The lower boiling components are separated at a higher pressure than is needed to separate all desired constituents; the residue is heated, volatile constituents of high boiling point are separated at a lower pressure, and the distillates are combined and rectified at the higher pressure.

<sup>54</sup> N. D. Gorchakov and I. U. Pogadin, *J. Applied Chem. (U.S.S.R.)* **18**, 538, 666, 669 (1945); N. D. Gorchakov and Z. S. Vanyushine, *Ibid.* **19**, 97 (1946).

<sup>55</sup> F. Jean, Fr. 643,501, April 5, 1927.

<sup>56</sup> A. Schmalenbach (to Coppers Co.). U. S. 1,802,539, April 28, 1931.

An economical continuous distilling apparatus suitable for the recovery of large amounts of solvents in the laboratory was developed by Schertz.<sup>57</sup> A large storage flask for the solvent to be distilled is placed high above the still so that the solvent can flow by gravity into the distilling flask after passing through a condenser used as a preheater. The flow of solvent into the still is regulated by an automatic float which maintains a constant level during the distillation.

A general discussion of solvent recovery by distillation is presented by White.<sup>58</sup>

Marwedel<sup>59</sup> recommends low-pressure steam distillation at about one atmosphere as a simple inexpensive method for the recovery of solvents from dirty residues containing nitrocellulose.

A semi-automatic, continuous flow still for the recovery of carbon tetrachloride used in the extraction of bituminous mixtures is described by Lovering.<sup>60</sup>

Merz<sup>61</sup> finds that distillation with low-pressure steam has the disadvantage that the distillate may contain moisture; he recommends distillation at 100° C. by means of steam coils and treatment of the residue with steam.

An apparatus for the recovery of volatile solvents such as trichloroethylene, carbon tetrachloride, and benzene, by distillation was patented by Wolff.<sup>62</sup>

A distillation apparatus for the fractional distillation of petroleum oils and solvents is described by Fenske<sup>63</sup> which can be controlled by means of a colorimeter, photoelectric cell, and other suitable equipment.

A distillation system especially adapted for

<sup>57</sup> F. M. Schertz, *Ind. Eng. Chem., Anal. Ed.* **7**, 441 (1936).

<sup>58</sup> A. White, *Metal Cleaning and Finishing* **8**, 401, 434 (1936).

<sup>59</sup> J. Marwedel, *Farbe u. Lack* **1937**, 465.

<sup>60</sup> W. R. Lovering, *Eng. News Record* **120**, 308 (1938).

<sup>61</sup> O. Merz, *Farbe u. Lack* **1938**, 101.

<sup>62</sup> G. Wolff (to Alexander Wacker Gesellschaft für elektrochemische Industrie, G.m.b.H.), Ger. 668,918, Dec. 13, 1938.

<sup>63</sup> M. H. Fenske (to Pennsylvania Research Corp.), U. S. 2,180,512, Nov. 21, 1931.

the recovery of solvents used in dry cleaning operations is described by Moran.<sup>64</sup>

A Piazza still having no eccentric movement was tried out in laboratory tests on wines, beers, water-alcohol-acetone mixtures, etc., by Rouzaut.<sup>65</sup> In this still, the condenser is isolated from the apparatus and the spiral system is supplanted by a gyratory disk that fractionates the liquid to be distilled by successive heating and cooling. The distillation process is not disturbed by foam in any way. The Piazza still is suitable to separate alcohol from acetone-butyl alcohol mixtures and also for the recovery of solvents in the laboratory.

A distillation column for fractionating oils and solvents, etc., is described by Wawretschek.<sup>66</sup>

A small distillation unit suitable for solvents and waxes is shown by Schlegel.<sup>67</sup>

A still for solvent recovery from solutions adapted for protracted or continuous operation as for producing drinking water from sea water is described by Yardley.<sup>68</sup>

Another distillation apparatus designed for the recovery of solvents used for cleaning oily or greasy machine parts is shown by Rowntree.<sup>69</sup>

A distillation apparatus for the purification of contaminated solvents is shown by Rowntree<sup>70</sup> which is designed for continuous operation and is provided with suitable means for automatic controls. A distillation apparatus with top feed which was designed chiefly to remove solvents from solutions without the use of high temperatures is described by Barthel.<sup>71</sup> A 40-mm vacuum is

<sup>64</sup> M. F. Moran, U. S. 2,226,828, Dec. 31, 1940.

<sup>65</sup> R. Rouzaut, *Anales soc. cient. argentina* **131**, 251 (1941).

<sup>66</sup> H. Wawretschek (to Curt Ankermann and Helmuth Wawretschek), Ger. 718,347, Feb. 19, 1942 (Cl. 12a.5).

<sup>67</sup> K. Schlegel (to Firma Arthur Schlegel), Ger. 730,515, Dec. 19, 1942 (Cl. 12a.5).

<sup>68</sup> V. A. Yardley, *Brit.* 564,634, Oct. 6, 1944.

<sup>69</sup> J. S. Rowntree, *Brit.* 570,079, June 21, 1945.

<sup>70</sup> J. S. Rowntree, U. S. 2,423,205, July 1, 1947.

<sup>71</sup> Wm. F. Barthel (to the United States of America, as represented by the Secretary of Agriculture), U. S. 2,438,988, April 6, 1948.

used while the lower sections and the upper sections of the column are heated to 100° C. by means of steam. An example of the use of this special distillation apparatus is the concentration of a 10% solution of pyrethrins in nitromethane. The latter may be evaporated at this low temperature from the solution without decomposing the solute, thereby producing a 98% concentration of the pyrethrins in the receiver. While passing through the heated column to the cool receiver, any given amount of pyrethrins remains in the still for only a few minutes.

Albin<sup>72</sup> found that petroleum solvents may be reclaimed at 25% of the original cost of these solvents. He used a compact distillation set-up constructed from standard dry-cleaning parts which has a capacity of 1000 barrels per year per shift. The loss experienced amounts to a little more than 10% and consists principally of water and residues.

An all-glass apparatus for the rapid removal of volatile solvents from solutions by

the use of reduced pressure is described by Barthel and Haller.<sup>73</sup>

#### SOLVENT RECOVERY BY USE OF A SOLVENT OF LOWER BOILING POINT

In a mixture of solvents used for extraction<sup>74</sup> it is possible to recover the high boiling point solvents by means of a lower boiling component of the mixture. Thus in the refining of oil by means of a mixture of sulfur dioxide and benzene, the latter may be recovered by blowing sulfur dioxide through the mixture. Ordinarily it is best to select the solvent of minimum boiling point, since the latter can later be removed most readily by means of a vacuum. The solvent having the maximum boiling point can be separated by fractional condensation and the remaining solvent may be used over again. Another consideration in the selection of the solvent chosen for blowing is the relative costs of the various components of the mixture.

<sup>73</sup> W. F. Barthel and H. L. Haller, *Ind. Eng. Chem., Anal. Ed.* 17, 529 (1945).

<sup>74</sup> Edeleanu G.m.b.H., Fr. 778,076, March 18, 1935; Fr. 799,510, March 18, 1935.

<sup>72</sup> J. Albin, *Iron Age* 161, No. 7, 74 (1948).

## CHAPTER IX

### TABLE OF SOLVENTS

#### EXPLANATORY NOTE

The values of physical constants obtained from technical bulletins, circulars, and datasheets distributed by solvent manufacturers are distinguished from those for the "pure" compounds or literature data by underlining the commercial data.

Characteristics. - The color, odor, aroma, taste, etc., of a solvent are detailed under this heading.

Boiling Point. - The term, boiling point, is considered equivalent to boiling range. All boiling points are at barometric pressure when indicated by the expression "(at 760 mm.)" equivalent to 1 standard atmosphere unless a different pressure is stated.

Specific Gravity. - The term, specific gravity, is considered numerically equivalent to density in these tables. The expression "(20/4)" or similar expression following a value for a specific gravity is to be understood as a specific gravity at 20° C. referred to water at 4° C. or other temperatures noted. If no temperature is noted, room temperature is understood. Where reference is made to temperature in Fahrenheit degrees, this is clearly stated. Liquid density is given in pounds per gallon at 60° F.

Refractive Index. - Values given for refractive index are at 20° C. for the D-line of sodium unless otherwise stated.

Uses. - The uses listed for any given solvent are merely representative. The listing of a given use for a solvent does not imply that the authors approve of such use. The laws and ordinances governing the use of solvents and chemicals in general speak for themselves.

Solubility. - The solubility of a given solvent in water is expressed as the amount at a given temperature with the expression "(in water)." The solubility of water in a given solvent is expressed as the amount at a given temperature with the expression "(of water)." This system is followed for other common organic solvents such as alcohol, ether, benzene, chloroform and the like.

Aniline Point. - The aniline point is given in degrees Fahrenheit.

Total Heating Values. - Total heating values refer to an actual cubic foot of gas at 77° F. and 1 standard atmosphere.



# ABBREVIATIONS USED IN TABLE

α]	specific rotation	<u>l</u> -	levorotatory
os.	absolute	l. or <i>ℓ</i> .	liter
ct-	active	lbs.	pounds
PI	American Petroleum Institute	<u>m</u> -	meta
as-	asymmetric	mg.	milligrams
S. T. M.	American Society for Testing Materials	ml.	milliliters
<u>sym</u> -	asymmetric	mm.	millimeters
<u>m</u> .	atmosphere	<u>n</u> -	normal
tu.	British thermal unit	<u>o</u> -	ortho
.	Centigrade degrees	<u>p</u> -	para
e.	cubic centimeter	<u>pri</u> - or <u>prim</u> -	primary
n.	centimeters	psia.	pounds per square inch atmospheric
a. ft.	cubic foot or cubic feet	<u>sec</u> -	secondary
.	dextrorotatory	sp. gr.	specific gravity
-	racemic	sq. cm./sec.	square centimeters per second
expl.	explodes	<u>sym</u> -	symmetrical
.	Fahrenheit	<u>tert</u> -	tertiary
al.	gram	<u>uns</u> -	unsymmetrical
	gallon	<u>vic</u> -	vicinal
	inactive	∞	miscible, generally miscible in all proportions

## ACETAL

## Synonyms:

acetaldehyde	diethylaldehyde
diethylacetal	ethylidenedi-
1,1-diethoxyethane	ethylic ether
diethylacetal	

Formula:  $\text{CH}_3\text{CH}(\text{OC}_2\text{H}_5)_2$ 

## Characteristics:

pleasant odor	nutty taste
volatile	mobile

Formula Weight: 118.2

## Boiling Point:

102.2 to 104°C.

107 to 112°C. (at 760 mm.)

## Specific Gravity:

0.821(22/4) 0.8254(20/4)

0.8257(20/20) 0.8461(0/4)

0.826 to 0.830 at 20°C.

6.9 lbs. per gal. at 20°C.

Refractive Index: 1.3819

## Surface Tension (dynes per cm.):

23.2 (air) at 5°C. 13.5 (air)

21.65 (air) at 20°C.

Inflammability Range (volume per cent in air): 1.65% (lower limit)

Flash Point: -5°F. (closed)

Specific Heat (gram-calories per g. per °C.): 0.520 (liquid)

## Uses:

cosmetics	organic syntheses
hypnotic medicine	nut flavors
perfumes	

## Solubility (grams per 100 ml.):

5.5 (in water) ∞ (ether)

∞ (in alcohol)

## Additional Data:

a constant boiling point mixture with alcohol boils at 78.2°C. and contains 34.5% acetal

decomposes in dilute acids

stable in alkali

auto-ignition temperature 446°F.

vapor density 4.08

## ACETALDEHYDE

## Synonyms:

acetic aldehyde	ethanal
acetylhydride	ethyl aldehyde
aldehyde	ethylic aldehyde

Formula:  $\text{CH}_3\text{CHO}$ 

## Characteristics:

fruity, pungent	mobile
odor	bitter, burning
fuming	taste
inflammable	minty flavor

Formula Weight: 44.1

Melting Point: -123.5 to -121°C.

## Boiling Point:

20.2 to 21°C. (at 760 mm.)

Vapor Pressure (in mm. of Hg) at various temperatures (°C.):

1(-85)	60(-31.4)
5(-65.1)	100(-22.6)
10(-56.8)	200(-10)
20(-47.8)	400(4.9)
40(-37.8)	760(20.2)

Gauge Pressure of Commercial Acetaldehyde (lbs. per sq. in.):

0(71)	15(110)
5(86)	20(120)
10(100)	42(150)

## Specific Gravity:

0.8257(20/20) 0.8461(0/4)

0.8254(20/4) 0.826-0.830(20/100)

6.9 lbs. per gal. at 20°C.

Specific Gravity of Acetaldehyde at Different Temperatures °F.

0.8130(20)	0.7852(60)
0.8060(30)	0.7845(61)
0.8026(35)	0.7838(62)
0.7991(40)	0.7831(63)
0.7956(45)	0.7824(64)
0.7921(50)	0.7817(65)
0.7907(52)	0.7810(66)
0.7893(54)	0.7803(67)
0.7880(56)	0.7796(68)
0.7859(58)	0.7789(69)
0.7859(59)	0.7782(70)

## Specific Gravity of Acetaldehyde-Water

## Solutions:

Percent Acet- aldehyde	Specific Gravity at 20° C.
100	0.781
85	0.855
70	0.923
60	0.958
55	0.972
45	0.991
30	0.001
15	1.003

Refractive Index: 1.3819

## Surface Tension (in dynes per cm.)

at Various Temperatures (°C.):

23.2(5) (air)	13.5(100) (air)
21.65(20) (air)	

## Viscosity (in centipoises) at Various

Temperatures (°C.):

0.28	0.23
0.25	

## Inflammability Range

(volume percent, in air):

4.0% (lower limit)	57% (upper limit)
--------------------	-------------------

## Flash Point:

-58° F. (open)	-17° F. (closed)
----------------	------------------

## Specific Heat (gram-calories per g.):

279 (liquid)

## Heat of Vaporization (gram-calories

per g.): 136 at 15° C.

## Heat of Combustion (kilogram-calories

per g.): 279 (liquid)

## Uses:

chemicals	rubber
disinfectants	accelerators
drugs	organic derivatives
dyes	vegetable rubber
flavors	yeast albumin
plastics	mirrors
preservatives	photography
resins	

## Solubility (in grams per 100 ml.):

∞ (in water)	∞ (in acetone)
∞ (in alcohol)	∞ (in benzene)
∞ (in ether)	∞ (in gasoline)

## Additional Data:

miscible in all proportions with solvent  
naphtha, toluene, turpentine, and  
xyleneweight of pure vapor, 1960 mg. per  
liter

vapor density, 1.52

coefficient of cubical expansion,  
0.0008839 per ° F.

gravity increment, 0.0007 per ° F.

auto-ignition temperature, 365° F.

should be stored cold

## ACETALDEHYDEAZINE

Synonyms: acetaldazine

Formula:  $\text{CH}_3\text{CH:NN:CHCH}_3$ 

Formula Weight: 84.1

Boiling Point: 95 to 96° C. (at 760 mm.)

Specific Gravity: 0.832 at 17° C.

## ACETIC ACID (glacial)

## Synonyms:

ethanoic acid	vinegar acid
methanecarboxylic acid	

Formula:  $\text{CH}_3\text{COOH}$ 

## Characteristics:

acetic	sour taste
pungent odor	

Formula Weight: 60.1

Melting Point: 16.7° C.

Boiling Point: 118.1° C. (at 760 mm.)

## Specific Gravity:

1.049(10/4)	1.0507(20/20)
1.040 at 8° Tw.	
<u>8.15 lbs. per gal. at 20° C.</u>	

Refractive Index: 1.3718

## Surface Tension (dynes per cm.):

28.6 (air) at 10° C.
27.6 (air) at 20° C.
22.2 (air) at 75° C.
28.8 (vapor) at 10° C.
27.8 (vapor) at 20° C.
22.3 (vapor) at 75° C.

## ACETIC ACID (glacial)

### ACETIC ACID (glacial) (Cont.)

#### Viscosity (centipoises):

1.22 at 20° C.	0.60 at 70° C.
1.04 at 30° C.	0.43 at 100° C.
0.80 at 50° C.	0.42 at 110° C.
0.70 at 59° C.	

Inflammability Range (volume percent in air): 4.0 (lower limit)

#### Flash Point:

135° F. (open)	104° F. (closed)
----------------	------------------

Specific Heat (gram-calories per g. per ° C.): 0.534 (liquid)

Heat of Vaporization (gram-calories per g.): 96.8 at 15° C.

Heat of Fusion (gram-calories per g.): 43.2 at 15° C.

Heat of Combustion (kilogram-calories per g.): 209.4 (liquid)

#### Strength of Commercial Solutions (%)

99 (glacial)	60
90	56
84	36
80	30
70	28

56 (redistilled)

#### Uses:

solvent for: essential oils, gums, some inorganic salts, many organic solids, resins, vegetable fiber

manufacture of: acetate films and rayons, acetates, adhesives, airplane lacquers, antichlor, disinfectants, dyes, drugs, fish glue, perfumes, plastics, soap, vinegar, white lead, synthetic fruit essences, pharmaceuticals

gives a vinegar like flavor to food products

hardening and developing solutions for photographic films

#### Solubility:

∞ (of water)	∞ (in benzene)
∞ (in water)	insoluble in
∞ (in alcohol)	carbon disulfide
∞ (in ether)	

#### Additional Data:

autoignition temperature, 1050° F.	temperature, 321.6° C.
vapor density, 2.07	critical pressure
acid number, 935.0	57.2 atm.

## ACETIC ANHYDRIDE

#### Synonyms:

acetic oxide	acetyl oxide
--------------	--------------

Formula:  $(\text{CH}_3\text{CO})_2\text{O}$

#### Characteristics:

very mobile	highly refractive
combustible	sharp acetic odor

Formula Weight: 102.2

Melting Point: -73° C.

Boiling Point: 139.6° C. (at 760 mm.)

#### Specific Gravity:

1.082(20/4)	1.076(25/25)
1.0830(20/20)	1.089(15.6/15.6)
9.0 lbs. per gal. at 20° C.	

Refractive Index: 1.3872

#### Surface Tension (dynes per cm.):

33.3 at 15° C.	18.6 at 140° C.
32.7 at 20° C.	

#### Viscosity (centipoises):

1.24 at 0° C.	0.70 at 40° C.
0.90 at 18° C.	0.49 at 100° C.
0.91 at 20° C.	0.31 at 130° C.

#### Flash Point:

150° F. (open)	121° F. (closed)
----------------	------------------

Heat of Vaporization (gram-calories per g.): 66.2 at 15° C.

Heat of Combustion (kilogram-calories per g.): 431.9 (liquid)

#### Uses:

acetate rayon	films
airplane dopes	rayon
aspirin	solvent in
cellulose acetate	preparation of
chemicals	organic compounds
drugs	

Solubility (grams per 100 ml.):

12 g. at 25° C.      ∞ (in carbon  
(in water)            tetrachloride)  
∞ (in alcohol)        soluble in  
∞ (in ether)           chloroform

Additional Data:

irritates mucous membranes and eyes  
autoignition temperature, 752° F.  
vapor density, 3.52  
critical temperature, 296° C.  
critical pressure, 46 atm.

ACETIN

Synonyms:

glyceryl acetate      monacetin  
glyceryl acetin        monoacetin  
glyceryl  
monoacetate

Formula:  $\text{CH}_3\text{COOC}_3\text{H}_5(\text{OH})_2$

Characteristics:

thick                    oily

Formula Weight: 134.1

Boiling Point: 158° C. (at 165 mm.)  
decomposes

Specific Gravity:

1.2212                    1.20(20/4)

Uses:

organic synthesis  
noncongealing dynamite  
smokeless powder gelatinization  
tanning agent  
solvent for: indolin dyes, Perkin's  
violet dye, basic dyes

ACETONE

Synonyms:

dimethyl acetal        propanone  
dimethyl ketone        pyroacetic ether  
ketopropane            pyroacetic spirit  
methylacetyl

Formula:  $\text{CH}_3\text{COCH}_3$

Characteristics:

hygroscopic            peppermint-like  
mild                      taste  
nonresidual            very volatile  
fragrant                highly inflammable  
agreeable odor

Formula Weight: 58.1

Melting Point: -94.6° C.

Boiling Point:

56.1 to 56.5° C. (at 760 mm.)  
55.8 to 56.6° C. (at 760 mm.)

Constant Boiling Point Acetone Mixtures

% Acetone	Other Solvent	B.P. at 760 mm.
80	chloroform	64.7
80	pentane	32.0
67	carbon disulfide	39.25
61.8	diethylamine	51.3
56	methanol	140
		(at 11.6 atm.)
52	methyl acetate	55.6
46	methanol	124
		(at 7.82 atm.)
43.5	isopropyl ether	53.3
32	methanol	102
		(at 4.56 atm.)
27	isobutyl chloride	55.8
23	carbon tetra- chloride	55.8
12	methanol	55.7

Specific Gravity:

Temper- ature in ° C.	Specific Gravity	Temper- ature in ° C.	Specific Gravity
15 . . .	0.7973	21 . . .	0.7911
16 . . .	0.7962	22 . . .	0.7899
17 . . .	0.7951	23 . . .	0.7887
18 . . .	0.7941	24 . . .	0.7857
19 . . .	0.7930	25 . . .	0.7863
20 . . .	0.7914		

0.7911(20/20)            0.7898(20/4)  
6.64 lbs. per gal. at 15° C.  
6.58 lbs. per gal. at 20° C.  
0.7915 to 0.7935(20/20)

## ACETONE (Cont.)

Specific Gravity of Acetone - Water Mixtures			
% Acetone	15°	20°	25°
100	0.79726	0.79197	0.78630
95	-	0.80748	0.80205
90	-	0.81297	0.81653
85	-	0.83588	0.83073
80	-	0.84981	0.84454
75	0.86442	0.86129	0.85533
70	0.88085	0.87545	0.87073
65	0.89271	0.88785	0.88282
60	0.90447	0.89953	0.89477
55	0.91526	0.91053	0.90603
50	0.92549	0.92051	0.91673
45	0.93518	0.93091	0.92678
40	0.94488	0.94075	0.93691
35	0.95293	0.94931	0.94547
30	0.96092	0.95748	0.95411
25	0.96783	0.96490	0.96221
20	0.97444	0.97210	0.96961
15	0.98038	0.97831	0.97604
10	0.98681	0.98513	0.98342
5	0.98921	0.99163	0.98979
0	0.99913	0.99826	0.99712

Refractive Index: 1.3591

Surface Tension (dynes per cm.):

26.2 at 0° C.	23.7 at 20° C.
23.3 at 16.8° C.	18.6 at 60° C.

Viscosity (centipoises):

Tempera- ture in ° C.	Vis- cosity	Tempera- ture in ° C.	Vis- cosity
-13. . . .	0.47	20. . . .	0.331
-13. . . .	0.450	25. . . .	0.316
0 . . . .	0.395	35. . . .	0.278
14.5 . .	0.330	41. . . .	0.280
19. . . .	0.303	50. . . .	0.256

Inflammability Range (volume per cent  
in air):

2.15 to 3.0 (lower limit)	11 to 13 (upper limit)
------------------------------	---------------------------

Flash Point:

150 F. (open)	0° F. (closed)
---------------	----------------

Specific Heat (gram-calories per g.  
per ° C.): liquid

0.3468 at 26 to 100° C.	0.3740 at 27 to 199° C.
0.4125 at 129 to 233° C.	

Heat of Vaporization (gram-calories  
per g.): 124.6 at 56.1° C.Heat of Fusion (gram-calories per g.):  
23.4

Heat of Combustion:

7.373 gram-calories per g.  
426.8 kilogram-calories per gram.  
(liquid)

Uses:

solvent for: acetylene, airplane dopes  
adhesive mixtures, artificial leather  
artificial perfume, camphor, cordite  
cleaners, resins, smokeless powder,  
starches, celluloid cements  
acetone derivatives leather dopes  
acetone oil lubricants  
asphalts lacquers  
acetate dopes and medicine  
varnishes nitrocellulose  
alcohol denaturant nigrosine  
acetylene storage prepared motor  
azo dyes fuels  
bitumens organic  
bituminous points derivatives  
camphor oil extraction  
celluloid paraffin  
chloroform purification  
cellulose acetate photographic film  
rayon and paint and varnish  
cements removers  
cleaning agent pyroxylin  
cotton dyeing with pharmaceuticals  
aniline black plastics  
dry cleaning fluids quinoline  
dyes rayons  
diphenylamine resins  
disinfectant rubber cements  
explosives rubber  
extraction medium purification  
fat extraction silk degumming  
hide treatment sulfonal  
indigo tanning extracts  
ionone vegetable oils  
iodoform waxes  
inks wool degreasing

## Solubility:

$\infty$ (of water)	soluble in
$\infty$ (in water)	chloroform
$\infty$ (in alcohol)	soluble in
$\infty$ (in ether)	most organic
$\infty$ (in gasoline)	solvents

## Dilution Ratios

With water . . . . .	0.21
With toluene . . . . .	4.95
With V. and P. naphtha . . . . .	0.55
Final concentration	
1/2 sec. R.S. nitrocellulose . . .	8%

## Additional Data:

vapor density, 2.00  
critical pressure, 47 atm.  
critical temperature, 235° C.  
electrical conductivity,  $5.5 \times 10^{-8}$   
mhos at 15° C.  
blush resistance (90° F.), 10% -  
1/2 sec. R.S. nitrocellulose solution  
coefficient of expansion, 0.00080 per  
° F., 0.00144 per ° C.  
relative humidity, clear 35%,  
blush 40%  
dielectric constant, 20.7 at 17° C.  
weight of vapor, 2590 mg. per liter  
autoignition temperature, 1118° F.

## Evaporation Rate at 95° F.

5% . . . . .	1/4 min.
25% . . . . .	11/4 min.
50% . . . . .	23/4 min.
75% . . . . .	41/4 min.
90% . . . . .	51/4 min.
95% . . . . .	51/2 min.

## ACETONEAZINE

## Synonyms:

diisopropylidenehydrazine  
dimethylketazine  
ketazine

Formula:  $[\text{CH}_3)_2\text{C:N}]_2$ 

Formula Weight: 112.2

Boiling Point: 131° C. (at 760 mm.)

Specific Gravity:

0.8381(25/4)      0.843(20/4)

Refractive Index: 1.45102 at 25° C.

## Solubility:

$\infty$ (in water)	$\infty$ (in ether)
$\infty$ (in alcohol)	

## ACETONE OILS

## Synonyms:

oil residue product from acetone  
distillation  
standard, light and heavy grades

## Formula:

mixture of aldehydes  
acetone condensation products,  
and ketones

## Characteristics:

inflammable      nearly odorless  
lemon yellow

## Boiling Point:

standard grade 76 to 160° C.  
(at 760 mm.)  
refined light grade 75 to 105° C.  
(at 760 mm.)  
heavy grade 80 to 225° C.  
(at 760 mm.)

## Specific Gravity:

standard grade 0.826 to 0.830  
refined light grade 0.812  
heavy grade 0.855 to 0.865

## Uses:

alcohol denaturant

## ACETONITRILE

## Synonyms:

ethyl nitrile      methyl cyanide

Formula:  $\text{CH}_3\text{CN}$ 

## Characteristics:

ethereal      limpid  
aromatic odor

Formula Weight: 41.1

Melting Point: -44 to -41° C.

## Boiling Point:

81.6 (at 760 mm.)      83 (at 760 mm.)

## Specific Gravity:

0.783(20/4)      0.7828(20/20)  
6.5 lbs. per gal. at 20° C.

## ACETONITRILE (Cont.)

## Refractive Index:

1.3460 at 16.5° C. 1.3442

## Surface Tension (dynes per cm.)

30.6 at 10° C. 20.2 at 90° C.

29.3 at 20° C.

## Viscosity:

0.00359 g. per cm. per sec. (at 25° C.)

## Specific Heat (gram-calories per g.

per ° C.): 0.541 (liquid)

## Heat of Vaporization (gram-calories

per g.): 174 at 15° C.

## Heat of Fusion (gram-calories per mol.):

2130

## Heat of Combustion (kilogram-calories

per g.): 302.4 (liquid)

## Uses:

solvent for: alkaloids, collodion,  
celluloid, fatty acids, cellulose  
ester, lacquers

organic synthesis      extracts  
denaturant              perfumes

## Solubility: ∞ (in water)

∞ (in alcohol) ∞ (in ether)

miscible with: water, methyl and  
ethyl alcohol, carbon tetrachloride,  
acetamide, methyl and ethyl acetate,  
ethylene chloride, ether, acetone,  
and most unsaturated hydrocarbons

immiscible with many saturated hydro-  
carbons

## Additional Data:

burns with a luminous flame  
poisonous

may be stored in steel containers  
constant boiling point mixture with  
water contains 84% acetonitrile and  
boils at 76° C.

dielectric constant, 38.8 at 20° C.

## ACETOPHENONE

## Synonyms:

acetylbenzene              phenyl methyl  
benzylmethide              ketone  
hypnone  
methyl phenyl  
ketone

Formula:  $C_6H_5COCH_3$ 

## Characteristics:

pungent odor              narcotic  
reminiscent of          bitter  
coumarin                  burning taste  
unstable

## Formula Weight: 120.1

## Melting Point: 19.7° C.; 20.5° C.; 22° C.

## Boiling Point:

202.3° C.                  202 to 202° C.  
(at 760 mm.)              (at 760 mm.)

## Specific Gravity:

1.033(15/15) 1.026(20/4)

## Refractive Index: 1.534

## Surface Tension (in dynes per cm.):

39.8 at 20° C.              33.3 at 75° C.  
22.8 at 175° C.

## Flash Point: 221° F. (closed)

## Uses:

pharmaceuticals      flavors  
perfumes  
solvent for: cellulose ethers,  
cellulose esters, resins

## Solubility:

insoluble in water  
soluble in: alcohol, ether, chloroform  
benzene, and concentrated sulfuric  
acid

## Additional Data: vapor density, 4.14

## ACETOXYACETONE

## Synonyms:

acetol acetate              acetylmethyl  
acetonyl acetate              acetate

Formula:  $CH_3COOCH_2COCH_3$ 

## Formula Weight: 116.1

## Boiling Point:

174 to 175° C.              65° C.  
(at 760 mm.)              (at 11 mm.)

## Specific Gravity: 1.075(20/4)

## Refractive Index: 1.415

**Solubility:**

very soluble in water, alcohol, and ether

**ACETYL BENZOYL****Synonyms:**

methyl phenyl diketone

**Formula:**  $\text{CH}_3\text{COCOC}_6\text{H}_5$

**Characteristics:**

yellow oily

**Formula Weight:** 148.2

**Boiling Point:** 216 to 218°C. (at 760 mm.)

**Specific Gravity:** 1.101(20/4)

**Solubility (in grams per 100 ml.):**

0.3 (in water) at 20°C.

**ACETYL BROMIDE**

**Synonyms:** ethanoyl bromide

**Formula:**  $\text{CH}_3\text{COBr}$

**Characteristics:** fumes

**Formula Weight:** 123

**Melting Point:** -96.5°C.

**Boiling Point:** 76 to 81°C. (at 760 mm.)

**Specific Gravity:**

1.663(16/4) 1.52(9.5/4)

**Uses:**

dyes organic synthesis  
perfumes pharmaceuticals

**Solubility:**

decomposes in  $\infty$  (in ether)  
water  $\infty$  (in chloroform)  
decomposes in  $\infty$  (in benzene)  
alcohol

**Additional Data:**

turns yellow in air irritates the eyes

**ACETYL CHLORIDE**

**Synonyms:** ethanoyl chloride

**Formula:**  $\text{CH}_3\text{COCl}$

**Characteristics:**

pungent odor clear, colorless to  
highly refractive pale yellow

**Formula Weight:** 78.5

**Melting Point:** -112°C.

**Boiling Point:** 51 to 52°C. (at 760 mm.)

**Specific Gravity:**

1.105(20/4) 1.1114(15.5/15.5)

**Refractive Index:** 1.3898

**Surface Tension (dynes per cm.):**

26.7 (vapor) at 14.8°C.

**Flash Point:** 40°F. (closed)

**Heat of Vaporization (gram-calories**

per g.): 78.9 at 15°C.

**Uses:**

acetylating agent pharmaceuticals  
test for water organic synthesis  
dyes

**Solubility:**

decomposes  $\infty$  (in chloroform)  
in water  $\infty$  (in benzene)  
decomposes  $\infty$  (in acetone)  
in alcohol  $\infty$  (in glacial  
acetic acid)  
 $\infty$  (in ether)

**Additional Data:**

gives a greenish tinge to a colorless  
flame  
vapor density, 2.70

**ACETYL FLUORIDE**

**Synonyms:** ethanoyl fluoride

**Formula:**  $\text{CH}_3\text{COF}$

**Formula Weight:** 62

**Melting Point:** < -60°C.

**Boiling Point:** 20.8°C. (at 770 mm.)

**Specific Gravity:** 0.993(20/4)

**Solubility (grams per 100 ml.):**

5 decomposes  $\infty$  (in benzene)  
(in water) soluble in acetic  
 $\infty$  (in alcohol) acid  
 $\infty$  (in ether) very slightly  
soluble in soluble in carbon  
chloroform disulfide

## ACETYL IODIDE

Synonyms: ethanoyl iodide

Formula:  $\text{CH}_3\text{COI}$ Characteristics:  
brown fumes                      suffocating odor

Formula Weight: 170

Boiling Point: 104 to 108°C. (at 760 mm.)

Specific Gravity: 1.980 to 2.06

Uses: organic synthesis

Solubility:

decomposes	soluble in ether
in water	soluble in
decomposes	benzene
in alcohol	

Additional Data:

turns brown in air  
should be stored in tightly closed  
containers and away from light

## 2-ACETYLTHIOPHENE

Formula:  $\text{CH}_3\text{COC}_4\text{H}_3\text{S}$ 

Formula Weight: 126

Melting Point: 9 to 10°C.

Boiling Point: 213 to 214°C. (at 760 mm.)

Specific Gravity: 1.171(20/4)

Refractive Index: 1.5660 to 1.5668

Uses: organic synthesis

## ACROLEIN

Synonyms:

acraldehyde	allyl aldehyde
acrylaldehyde	2-propenal
acrylic aldehyde	

Formula:  $\text{CH}_2\text{:CHCHO}$ 

Characteristics:

colorless to yellow	pungent odor
very refractive	volatile
choking	inflammable
disagreeable	

Formula Weight: 56.1

Melting Point: -87.7 to -86.95

Boiling Point:

52.5 to 52.69°C. (at 760 mm.)

dt/dp = 0.035° per mm. of Hg

Specific Gravity:

0.86205(0/4)                      0.8269(30/4)

0.8506(10/4)                      0.8179(40/4)

0.8447(15/4)                      0.8075(50/4)

0.8389(20/4)

6.99 lbs. per gal. at 20°C.

Refractive Index:

1.3998 to 1.4017                      1.4048 at 15°C.

Flash Point:

0°F. (open)                      -15°F. (closed)

Specific Heat (gram-calories per g.):

0.511 (liquid)

Heat of Vaporization:

123 gram-calories	6900 gram-
per g.	calories per mo

Heat of Combustion:

6961 gram-calories	389.6 kilogram-
per g. (liquid)	calories per g.
	(liquid)

Uses:

colloidal metals	fat rendering
disinfectants	galvanizing
organic synthesis	tinsmithing
artificial resins	perfumes
soap	plastics
coffee roasting	linoleum
dye intermediates	

Solubility (in grams per 100 ml.):

40 (in water)	soluble in ether
soluble in alcohol	

Additional Data:

unstable	vapor density,
polymerizes to	1.94
disacryl	irritates the eyes
volatility 407,000 mg. per cu. m.	
at 20°C.	
coefficient of expansion at 15°C.,	
0.00137 per degree	
weight of pure vapor, 2500 mg.	
per liter	

## ACRYLIC ACID

## Synonyms:

acroleic acid	propene acid
ethylenecarboxylic acid	propenoic acid
	vinylformic acid

Formula:  $\text{CH}_2\text{:CHCOOH}$ 

## Characteristics:

nearly colorless      pungent odor

Formula Weight: 72.1

Melting Point: 12.3 to 13° C.

Boiling Point: 141 to 142° C. (at 760 mm.)

Specific Gravity: 1.062(14/4)

Refractive Index: 1.4222 at 4° C.

Heat of Fusion (gram-calories per g.): 37.0 at 15° C.

Heat of Combustion (kilogram-calories per g.): 327.5

## Uses:

cleansing and wash-	paints and
ing compounds	varnishes
emulsion breaker	synthetic rubber
organic synthesis	

## Solubility:

$\infty$ (in water)	$\infty$ (in ether)
$\infty$ (in alcohol)	

Additional Data: polymerizes quickly

## ACRYLIC ANHYDRIDE

Formula:  $(\text{CH}_2\text{:CHCO})_2\text{O}$ 

Formula Weight: 126.1

Boiling Point: 97° C. (at 35 mm.)

Refractive Index: 1.094 at 0° C.

## ACRYLONITRILE

## Synonyms:

acrylic nitrile	vinyl cyanide
propenenitrile	

Formula:  $\text{CH}_2\text{:CHCN}$ 

## Characteristics:

mobile	inflammable
mild odor	somewhat toxic

Formula Weight: 53.1

Melting Point: -84 to -82° C.

## Boiling Point:

78 to 79° C.	77.3° C.
(at 760 mm.)	(at 760 mm.)

## Specific Gravity:

0.797(20/4)	0.8004
0.8060 to 0.8070	at 25° C.
at 20° C.	

## Refractive Index:

1.393 to 1.3884 at 25° C.

## Inflammability Range (volume per cent in air):

3.05% (lower limit)	17.10 (upper limit)
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Flash Point: 32° F. (open)

Specific Heat (gram-calories per g. per ° C.): 0.50± 0.003

Heat of Vaporization: 7800 gram-calories per mol at 0 to 80° C.

Heat of Combustion: 420.5 kilogram-calories per mol.

Use: organic synthesis

## Solubility (grams per 100 ml.):

Of Water	In Water
2.1 at 0° C.	7.2 at 0° C.
3.1 at 20° C.	7.3 at 20° C.
4.8 at 40° C.	7.9 at 40° C.

$\infty$ (in alcohol)	$\infty$ (in ethyl acetate)
$\infty$ (in ether)	
$\infty$ (in chloroform)	$\infty$ (in methyl alcohol)
$\infty$ (in acetone)	
$\infty$ (in carbon tetrachloride)	$\infty$ (in toluene)
$\infty$ (in benzene)	$\infty$ (in petroleum ether)

## Additional Data:

soluble in all common organic solvents  
 density, 0.8281 - 0.001106t  
 (0 to 30° C.)  
 dielectric constant, 38 at 33.5 mega-cycles  
 azeotropic mixture containing 19% of water boils at 70.5 to 70.7° C.  
 autoignition temperature, 898° F.  
 vapor density, 1.83  
 avoid exposure to vapors

## ADIPONITRILE

## Synonyms:

adipyl dinitrile	tetramethylene dicyanide
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Formula:  $\text{CN}(\text{CH}_2)_4\text{CN}$ 

Formula Weight: 108.1

Melting Point:  $1^\circ\text{C}$ .Boiling Point:  $295^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.951(19/19)

## Solubility:

very slightly soluble in water	very slightly soluble in ether
soluble in alcohol	

## ADIPYL CHLORIDE

Synonyms: hexanedioyl chloride

Formula:  $\text{ClCO}(\text{CH}_2)_4\text{COCl}$ 

Formula Weight: 183.0

## Boiling Point:

125 to $128^\circ\text{C}$ . (at 11 mm.)	decomposes slightly
112 to $115^\circ\text{C}$ . (at 10 mm.)	

Solubility: decomposes in hot water and hot alcohol

## ALDOL

## Synonyms:

acetaldol	oxybutyric
3-butanolal	aldehyde
3-hydroxybutanal	
2- or $\beta$ -hydroxybutyraldehyde	

Formula:  $\text{CH}_3\text{CHOHCH}_2\text{CHO}$ 

## Characteristics:

colorless to pale yellow	syrupey
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Formula Weight: 88.1

Melting Point: below  $0^\circ\text{C}$ .

## Boiling Point:

$85^\circ\text{C}$ . (at 760 mm.)	$83^\circ\text{C}$ . (at 20 mm.)
decomposes	

Vapor Pressure (mm. Hg.):

 $21.3$  at  $20^\circ\text{C}$ .

Specific Gravity:

1.103	1.1047
1.1098	

 $9.2$  lbs. per gal. at  $20^\circ\text{C}$ .Flash Point:  $181.4^\circ\text{C}$ . (closed)Specific Heat (gram-calories per g. per  $^\circ\text{C}$ .): 0.737 (liquid)

Heat of Combustion (kilogram-calories per g.): 546.6 (liquid)

## Uses:

cadmium plating	ore flotation
cellulose acetate and nitrate	rubber accelerators and resistor
engraving	synthetic resins
fungicide	solvent for:
organic synthesis	dyes, drugs

## Solubility:

$\infty$ (in water)	$\infty$ (in ether)
$\infty$ (in alcohol)	

## Additional Data:

polymerizes readily to paraldehyde  
 miscible with most organic solvents  
 distillation at atmospheric pressure  
 decomposes it to crotonaldehyde and water  
 vapor density, 3.04

## ALLYL ACETATE

## Synonyms:

acetic acid allyl ester	2-propenyl ethanoate
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Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}=\text{CH}_2$ 

Formula Weight: 100.1

## Boiling Point:

 $103$  to  $104^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.928(20/4)

Refractive Index: 1.4045

## Solubility:

insoluble in water	$\infty$ (in ether)
$\infty$ (in alcohol)	

## ALLYL ALCOHOL

## Synonyms:

2-propen-1-al      propen-1-al-3

Formula:  $\text{CH}_2\text{:CHCH}_2\text{OH}$ 

## Characteristics:

mobile liquid      toxic  
pungent odor

Formula Weight: 58.1

Melting Point:  $-129^\circ\text{C}$ .

## Boiling Point:

96 to  $97^\circ\text{C}$ .      94 to  $98^\circ\text{C}$ .  
(at 760 mm.)      (at 760 mm.)

## Specific Gravity:

0.854(20/4)      0.8534(20/20)  
0.857 at  $15^\circ\text{C}$ .  
7.10 lbs. per gal. at  $20^\circ\text{C}$ .

## Refractive Index:

1.4135 at  $20^\circ\text{C}$ .      1.4111 at  $25^\circ\text{C}$ .  
1.4126

## Surface Tension (dynes per cm.):

27.6 at  $0^\circ\text{C}$ .      24.92 at  $30^\circ\text{C}$ .  
26.15 at  $15^\circ\text{C}$ .      19.2 at  $95^\circ\text{C}$ .  
25.8 at  $20^\circ\text{C}$ .

## Viscosity (centipoises):

2.145 at  $0^\circ\text{C}$ .      0.914 at  $40^\circ\text{C}$ .  
1.486 at  $15^\circ\text{C}$ .      0.553 at  $70^\circ\text{C}$ .  
1.363 at  $20^\circ\text{C}$ .      0.414 at  $90^\circ\text{C}$ .  
1.072 at  $30^\circ\text{C}$ .

## Inflammability Range (volume per cent in air):

2.50% (lower      18.00% (upper  
limit)      limit)

## Flash Point:

75 to  $90^\circ\text{F}$ .      70 to  $72^\circ\text{C}$ .  
(open)      (closed)Specific Heat (gram-calories per g. per  $^\circ\text{C}$ .):0.665 at 20 to  $95^\circ\text{C}$ .Heat of Vaporization (in gram-calories per g.): 163 at  $15^\circ\text{C}$ .

## Heat of Combustion:

7620 gram-calories      442.2 kilogram-  
per g.      calories per g.

## Uses:

allyl compounds      perfumes  
cleansing and wash-      pharmaceuticals  
ing compounds      insecticides  
emulsions      lubricants  
flavors      organic synthesis

## Solubility:

 $\infty$  (of water)       $\infty$  (in ether)  
 $\infty$  (in water)      soluble in  
 $\infty$  (in alcohol)      chloroform

## Additional Data:

autoignition temperature,  $713^\circ\text{F}$ .  
irritates the eyes  
solidifies at  $-50^\circ\text{C}$ .  
vapor density, 2.00  
coefficient of expansion, 0.000572  
per  $^\circ\text{F}$ .  
an azeotropic mixture contains 72.3%  
of the alcohol and has a constant  
boiling point of  $87.5^\circ\text{C}$ .  
use carefully in a well-ventilated  
room  
critical temperature,  $271.9^\circ\text{C}$ .  
ignition temperature,  $443^\circ\text{C}$ . (in air)  
 $348^\circ\text{C}$ . (in oxygen)  
liquid density:  
0.8564(15/4)      0.8476(25/4)  
0.8520(20/4)      0.8501(25/25)

## ALLYLAMINE

## Synonyms:

3-aminopropylene      2-propenylamine

Formula:  $\text{CH}_2\text{:CHCH}_2\text{NH}_2$ 

## Characteristics:

ammonia odor      burning odor

Formula Weight: 57.1

Boiling Point:  $53.2^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.761(10/4)      0.744(20/20)

## Refractive Index:

1.4186 to 1.4194 at  $32^\circ\text{C}$ .

## Viscosity (in centipoises):

0.506 at  $130^\circ\text{C}$ .

## ALLYLAMINE (Cont.)

## Solubility:

$\infty$  (in water)                      soluble in  
 $\infty$  (in alcohol)                    chloroform  
 $\infty$  (in ether)

## Additional Data:

causes tears and sneezing  
 should be stored in tightly closed  
 container

N-ALLYLANILINE

Synonyms: N-(2-propenyl) aniline

Formula:  $\text{CH}_2\text{:CHCH}_2\text{NHC}_6\text{H}_5$

## Characteristics

yellow                                  oily

Formula Weight: 133.2

## Boiling Point:

209° C.                                  217 to 219° C.  
 (at 760 mm.)                        (at 736 mm.)

Specific Gravity: 0.982(15/4)

## Solubility:

insoluble in water                   $\infty$  (in ether)  
 soluble in alcohol

## ALLYLBENZENE

Synonyms:  $\gamma$ -phenylpropylene

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{CH:CH}_2$

Formula Weight: 188.2

## Boiling Point:

156 to 157° C. ( at 760 mm.)

Specific Gravity: 0.893(20/0)

## Solubility:

insoluble in                          soluble in  
 water                                  ether  
 soluble in alcohol

## ALLYL BENZOATE

## Synonyms:

benzoic acid allyl ester

Formula:  $\text{C}_6\text{H}_5\text{COOC}_3\text{H}_5$

## Characteristics:

yellow                                  oily

Formula Weight: 162.2

Boiling Point: 230° C. (at 760 mm.)

Specific Gravity: 1.058(15/15)

## Solubility:

insoluble in water                  soluble in ether  
 soluble in alcohol

## ALLYL BUTYRATE

## Synonyms:

butyric acid                          2-propenyl  
 allyl ester                              butanoate

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{COOCH}_2\text{CH:CH}_2$

Formula Weight: 128.2

Boiling Point: 143° C. (at 760 mm.)

## Solubility:

insoluble in water                  soluble in ether  
 soluble in alcohol

## ALLYL CAPROATE

## Synonyms:

allyl hexanoate                      capryl ether  
 caproic acid  
 allyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{COOCH}_2\text{CH:CH}_2$

## Characteristics:

pale yellow                          pineapple flavor

Formula Weight: 156.2

## Boiling Point:

185 to 187° C. (at 760 mm.)

Uses: pineapple essences

## Solubility:

insoluble in water                  soluble in ether  
 soluble in alcohol

## ALLYL ETHER

## Synonyms:

diallyl ether                          3-(2-propenoxy)  
    propene

Formula:  $(\text{CH}_2\text{:CHCH}_2)_2\text{O}$



## ALLYL METHYL ETHER

Synonyms: methyl allyl ether

Formula:  $\text{CH}_3\text{OCH}_2\text{CH}:\text{CH}_2$ 

Formula Weight: 72.1

Boiling Point: 42 to 43°C. ( at 757 mm.)

Specific Gravity: 0.77 at 11°C.

Solubility:

very slightly	$\infty$ (in alcohol)
soluble in water	$\infty$ (in ether)

## ALLYL OXALATE

Synonyms:

diallyl oxalate	oxalic acid
oxalic acid	diallyl ester
allyl ester	

Formula:  $(\text{COOC}_3\text{H}_5)_2$ 

Formula Weight: 170.2

Boiling Point: 217°C. (at 759 mm.)

Specific Gravity: 1.055 at 15.5°C.

Solubility:

insoluble in water	soluble in alcohol
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## ALLYL PHENYL ETHER

Synonyms:

2-propenoxy- benzene	phenyl allyl ether
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Formula:  $\text{CH}_2:\text{CHCH}_2\text{OC}_6\text{H}_5$ 

Characteristics: oily

Formula Weight: 134.2

Boiling Point:

191.7°C. (at 760 mm.)	85°C. (at 19 mm.)
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Specific Gravity: 0.986(15/15)

Solubility:

insoluble in water	$\infty$ (in ether)
soluble in alcohol	

## ALLYL PROPIONATE

Synonyms:

propionic acid allyl ester

Formula:  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}:\text{CH}_2$ 

Formula Weight: 114.1

Boiling Point: 125.4°C. ( at 774 mm.)

## ALLYL SULFIDE

Synonyms:

allyl thioether	3-(2-propenylthio)
diallyldisulfide	propene
2-propenyl sulfide	thioallyl ether
garlic oil	

Formula:  $(\text{CH}_2:\text{CHCH}_2)_2\text{S}$ 

Characteristics:

oily	garlic-like odor
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Formula Weight: 114.2

Melting Point: -83°C.

Boiling Point:

140 to 142°C. (at 760 mm.)	138.6°C. (at 758 mm.)
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Specific Gravity: 0.8877(27/4)

Refractive Index: 1.4877 at 27°C.

Solubility:

slightly soluble	$\infty$ (in alcohol)
in water	$\infty$ (in ether)
soluble in chloroform, carbon tetra- chloride, and carbon disulfide	

## ALLYL THIOCYANATE

Synonyms:

allyl sulfocyanate	thiocyanic acid
2-propenyl	allyl ester
thiocyanate	

Formula:  $\text{CH}_2:\text{CHCH}_2\text{CNS}$ 

Characteristics: oily

Formula Weight: 99.2

Boiling Point: 161°C. (at 760 mm.)

Specific Gravity:

1.056 at 15°C.	1.071 at 0°C.
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Solubility:

very slightly sol- uble in water	very soluble in ether
very soluble in alcohol	

## ALLYL TRISULFIDE

Synonyms: diallyl trisulfide

Formula:  $(C_3H_5)_2S_3$ 

Characteristics:

odor is like that of allyl sulfide

Formula Weight: 178.3

Boiling Point:

140° C.	112 to 122° C.
(at 760 mm.)	(at 16 mm.)

Specific Gravity: 1.085 at 15° C.

Solubility:

insoluble in water	∞ (in ether)
insoluble in alcohol	

## 4-ALLYLVERATROLE

Synonyms:

eugenol methyl	methyleugenol
ether	
eugenyl methyl	
ether	

Formula:  $C_3H_5C_6H_3(OCH_3)_2$ 

Formula Weight: 178.2

Boiling Point:

248 to 249° C. (at 760 mm.)

Specific Gravity: 1.055 at 15° C.

Refractive Index: 1.5383 at 17° C.

Solubility (grams per 100 ml.):

insoluble in water	∞ (in ether)
25 (in 60% alcohol)	

o-AMINOACETOPHENONE

Synonyms:

<u>o</u> -acetylaniline
<u>o</u> -aminophenyl methyl ketone

Formula:  $NH_2C_6H_4COCH_3$ 

Characteristics:

yellow	oily
--------	------

Formula Weight: 135.2

Boiling Point:

250 to 252° C. (at 760 mm.)
slight decomposition

Solubility:

insoluble in water	∞ (in ether)
∞ (in alcohol)	

## 2-AMINO-1-BUTANOL

Synonyms: butanolamine

Formula:  $CH_3CH_2CH(NH_2)CH_2OH$ 

Characteristics: amine odor

Formula Weight: 89.1

Melting Point: -2° C.

Boiling Point:

174 to 178° C.	79 to 80° C.
(at 760 mm.)	(at 10 mm.)

Vapor Pressure (in mm. of Hg.):

0.5 at 20° C.

Specific Gravity:

0.944(20/20)
7.85 lbs. per gal. at 20° C.

Refractive Index: 1.453

Solubility:

∞ (in water)	∞ (in ether)
∞ (in alcohol)	

Additional Data:

pH of 0.1 M aqueous solution is 11.1 at 20° C.

## 4-AMINO-2-BUTANOL

Formula:  $CH_3CHOHCH_2CH_2NH_2$ 

Characteristics: amine odor

Formula Weight: 89.1

Boiling Point:

175 to 185° C. (at 760 mm.)

Specific Gravity: 0.918(20/20)

Refractive Index: 1.453

Solubility:

soluble in water, methyl alcohol, ether, acetone, benzene, gasoline, and ethyl acetate

## 3-AMINOCYMENE

Synonyms: 1,3,4,-thymylamine

Formula:  $\text{CH}_3(\text{NH}_2)\text{C}_6\text{H}_3\text{C}_3\text{H}_7$ 

Characteristics: oily

Formula Weight: 149.2

Boiling Point:  $230^\circ\text{C}$ . (at 760 mm.)

Solubility:

very slightly sol-      soluble in ether  
 uble in water  
 soluble in alcohol

o-AMINODICYCLOHEXYLSynonyms: 2-or o-aminobicyclohexyl  
2-aminodicyclohexylFormula:  $\text{C}_6\text{H}_{11}\text{C}_6\text{H}_{10}\text{NH}_2$ 

Formula Weight: 181.3

Boiling Point:  $270^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 0.933(25/25)

Uses:

possible interme-      plasticizers  
 diate for dyes      pharmaceuticals  
 insecticides      rubber chemicals

## 2-AMINOETHANOL

Synonyms:

$\beta$ -aminoethyl       $\beta$ -or 2-hydroxy-  
 alcohol      ethylamine  
 ethanolamine      monoethanolamine  
 ethylolamine

Formula:  $\text{CH}_2\text{OHCH}_2\text{NH}_2$ 

Characteristics:

oily      ammoniacal odor  
 somewhat viscous

Formula Weight: 61.1

Melting Point:  $10.5^\circ\text{C}$ .

Boiling Point:

$172.2^\circ\text{C}$ .       $100^\circ\text{C}$ .  
 (at 760 mm.)      (at 50 mm.)  
 $160$  to  $176^\circ\text{C}$ .       $69^\circ\text{C}$ .  
 (at 760 mm.)      (at 10 mm.)

Vapor Pressure (mm. Hg.)

0.48 at  $20^\circ\text{C}$ .

Specific Gravity:

1.0180(20/4)      1.022 at  $20^\circ\text{C}$ .1.0179(20/20)8.5 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:

1.4539      1.4544Viscosity (centipoises): 24.1 at  $20^\circ\text{C}$ .Flash Point: 200 to  $215^\circ\text{F}$ . (open)Heat of Vaporization: 355 Btu. per lb.

Uses:

soap manufacture  
 separation of carbon dioxide from  
 inert gases  
 organic synthesis of detergents  
 alkaline conditioning agent  
 plasticizer

Solubility (grams per 100 ml.):

$\infty$  (of water)       $\infty$  (in alcohol)  
 $\infty$  (in water)      0.72 (in ether)  
 soluble in chloroform  
 slightly soluble in benzene  
 soluble in carbon tetrachloride

Additional Data:

strongly alkaline  
 pH of 25% solution at  $25^\circ\text{C}$ . is 12.1  
 hygroscopic  
 vapor density, 2.10

## 2-(2-AMINOETHYLAMINOETHANOL)

Synonyms:

2-aminoethyl-      hydroxyethyl  
 ethanolamine      ethylenediamine

Formula:

 $\text{NH}_2\text{CH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2$ 

Characteristics:

hygroscopic      mildly ammoniacal odor

Formula Weight: 104.2

Boiling Point:  $243.7^\circ\text{C}$ . ( at 760 mm.)

Vapor Pressure (mm. Hg.):

0.01 at  $20^\circ\text{C}$ .

Specific Gravity: 1.0304(20/20)  
8.6 lbs. per gal. at 20° C.

Flash Point 275° F. (open)

Uses:

organic synthesis	pharmaceuticals
of dyes	resins
flotation agents	rubber products
insecticides	textile specialties

Solubility:

∞ (of water)                      ∞ (in water)

1-AMINO-2-METHYLBUTANE

Synonyms: amylamine

Formula:  $C_2H_5CH(CH_3)CH_2NH_2$

Formula Weight: 87.2

Boiling Point: 95 to 96° C. (at 760 mm.)

Specific Gravity: 0.755 at 18° C.

Solubility:

∞ (in water)                      ∞ (in ether)  
 ∞ (in alcohol)

1-AMINO-2,3-PROPANEDIOL

Synonyms: mono-*α*-glycerolamine

Formula:  $CH_2OHCHOHCH_2NH_2$

Formula Weight: 91.1

Boiling Point:

264° C. (at 760 mm.)  
 slight decomposition

Specific Gravity: 1.185(25/25)

Solubility:

soluble in water, alcohol, and ether  
 insoluble in benzene

1-AMINO-2-PROPANOL

Synonyms:

α'-aminoisopropyl    isopropanolamine  
 alcohol

Formula:  $NH_2CH_2CHOHCH_3$

Characteristics:

somewhat viscous    distinct ammonia-  
                                  cal odor

Formula Weight: 75.1

Boiling Point:

160 to 161° C.                      45° C. (at 5 mm.)  
 (at 760 mm.)  
159.9° C. (at 760 mm.)

Specific Gravity:

0.973 at 18° C.                      0.9619(20/20)  
8.2 lbs. per gal. at 20° C.

Viscosity (centipoises): 30.2 at 20° C.

Flash Point: 171° F. (closed)

Uses:

synthesis of	detergents
cutting oils	lather compounds
emulsifying agents	pharmaceuticals
insecticides	

Solubility:

∞ (of water)                      soluble in alcohol  
 ∞ (in water)                      insoluble in ether

Additional Data:

equivalent weight 75

2-AMINOTHIOPHENE

Synonyms:

2,3-dihydro-2-iminothiophene  
 thiophenine

Formula:  $NH_2C_4H_3S$

Characteristics:

yellow                      oily

Formula Weight: 99.2

Boiling Point: 77 to 79° C. (at 11 mm.)

61 to 62° C. (at 1 mm.)  
 with decomposition

Solubility:

very soluble in                      insoluble in ether  
 water  
 soluble in alcohol

AMYL ACETATE

Synonyms:

acetic acid	banana oil
amyl ester	1-pentanol acetate
amyl acetic ester	pear oil

Formula:  $CH_3COO(CH_2)_4CH_3$

AMYL ACETATE (Cont.)

Characteristics: banana-like odor

Formula Weight: 130.2

Melting Point: -75° C.

Boiling Point:

145 to 147° C. (at 760 mm.)	148.4° C. (at 737 mm.)
--------------------------------	---------------------------

Specific Gravity: 0.879(20/20)

Refractive Index: 1.4012

Viscosity (centipoises):

1.06 at 10° C.	0.77 at 30° C.
0.89 at 20° C.	0.65 at 60° C.

Inflammability Range (volume per cent in air): 1.1 (lower limit)

Flash Point:

80° F. (open)	76° F. (closed)
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Uses:

airplane dopes	photographic films
artificial leather	plastic wood
bronzing liquids	waterproofing
camphor	compositions
celluloid products	varnishes
cements	solvent in the
coated paper	manufacture of
collodion	nitrocellulose
confectionery	perfumes
food preparations	rayons
fruit flavors	soaps
fireproofing	dyeing
compounds	textile printing
lacquers	and finishing
linoleum	photoengraving

Solubility (grams per 100 ml.):

0.18 at 20° C. (in water)	∞ (in alcohol) ∞ (in ether)
------------------------------	--------------------------------

Additional Data:

autoignition temperature 714° F.  
vapor density, 4.49  
weight of pure vapor, 5800 mg. per liter

AMYL ACETATE

Commercial grade, 85 to 88% acetic acid ester of fusel oil

Formula:  $\text{CH}_3\text{COOC}_5\text{H}_{11}$

Formula Weight: 130.2

Boiling Point:

110 to 150° C. (at 760 mm.)

Vapor Pressure (mm. Hg.): 9 at 30° C.

Specific Gravity: 0.857 to 0.865(20/20)  
7.17 lbs. per gal. at 20° C.

Viscosity (centipoises):

10% 1/2 sec. RS nitrocellulose  
solution 4.3

Inflammability Range:

combustible but not flammable

Flash Point:

93° F. (open)	111° F. (closed)
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Uses: see amyl acetate

Solubility (grams per 100 ml.):

2.4 at 25° C. (of water)	2 (in water)
-----------------------------	--------------

Additional Data: coefficient of expansion

0.00066 per ° F.	0.00119 per ° C.
------------------	------------------

Dilution Ratios

(Nitrocellulose Solution Method)

with toluene	with petroleum
... 2.7	naphtha. . . 1.4

Evaporation Rate at 95° F.  
(in minutes)

% amyl acetate	minutes
5 . . . . .	1
25 . . . . .	6
50 . . . . .	15 1/4
75 . . . . .	28 1/2
90 . . . . .	41 1/4
95 . . . . .	47 1/2

Blush Resistance at 90° F.

10% 1/2 sec. RS Nitrocellulose Solution

	Clear	Blush
Relative humidity. . . 80%		85%

AMYL ACETATE

Synonyms:

Pentacetate, which is a mixture of isomeric amyl acetates and amyl alcohols produced by the treatment of acetic acid with Pentasol

Formula:  
not less than 85% ester as amyl acetate

Boiling Point:  
126 to 155° C. (at 760 mm.)

Vapor Pressure (mm. Hg.): 9 at 30° C.

Specific Gravity: 0.86 to 0.87(20/10)  
7.21 lbs. per gal. at 20° C.

Refractive Index: 1.401

Viscosity (centipoises): 0.683 at 40° C.

Flash Point: 107° F. (open)

Specific Heat (gram-calories per g. per ° C.): 0.491 (liquid)

Heat of Vaporization (gram-calories per g.): 68.5

Uses:  
nitrocellulose                    penicillin  
lacquers                         extractant  
organic solvent

Solubility (cc. per 100 cc.):  
1.5 (of water)                    1 (in water)

Additional Data:  
water azeotrope at 92 to 95° C. contains 67% Pentacetate  
coefficient of expansion 0.00110 at 10 to 35° C.

Dilution Ratios (basis 8% solid)

With toluene . . . . .	2.1
With petroleum naphtha . . . . .	1.3
With xylene . . . . .	2.4
With 50% toluene . . . . .	1.9

Evaporation Rate at 114.8° F. (in minutes)

% Pentacetate	minutes
25. . . . .	3.92
50. . . . .	7.92
75. . . . .	12.50
100. . . . .	20.00

sec-AMYL ACETATE

Synonyms: d-methylbutyl acetate

Formula:  
CH3COOCH(CH3)CH2CH2CH3

Characteristics: ethereal odor

Formula Weight: 130.2

Boiling Point:  
133.5° C. (at 760 mm.)  
126 to 145° C. (at 760 mm.)

Vapor Pressure (mm. Hg.): 10 at 30° C.

Specific Gravity: 0.922 at 0° C.  
0.862 to 0.866(20/20)  
7.18 lbs. per gal. at 20° C.

Inflammability Range (volume per cent in air): 1.2 (lower limit)

Flash Point: 89° F. (closed)

Uses:  
medium boiling                    cements  
solvent                            lacquers  
artificial leather                leather finish  
and pearls                        linoleum  
plastic wood                      nail enamel  
automobile                        textile compounds  
polishes                          wallpaper  
celluloid products  
solvent for: ethyl cellulose and nitro-cellulose, airplane dopes

Solubility:  
very slightly soluble in water  
water is very slightly soluble in this compound  
∞ (in alcohol)                    ∞ (in ether)

Additional Data:  
coefficient of expansion 0.00060 per ° F.  
0.0010 per ° C.  
vapor density, 4.5  
weight of pure vapor, 5800 mg. per liter

Blush Resistance at 90° F.  
10% RS Nitrocellulose Solution

	Clear	Blush
Relative humidity . . . .	85%	90%

tert-AMYL ACETATE

Formula:  
CH3COOC(CH3)2C2H5

Formula Weight: 130.2

Boiling Point: 124.5° C. (at 749 mm.)

tert-AMYL ACETATE (Cont.)

Specific Gravity: 0.874 at 19° C.

## Solubility:

very slightly sol- uble in water	∞ (in alcohol) ∞ (in ether)
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## AMYL ALCOHOL

## Synonyms:

butyl carbinol	1-pentanol
butyl methanol	

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$ 

Characteristics: mild odor

Formula Weight: 88.2

Melting Point: -78.5° C.

## Boiling Point:

137.8 to 138° C. (at 760 mm.)

## Specific Gravity:

0.8168(20/20)	0.8144(20/20)
6.83 lbs. per gal.	

## Refractive Index:

1.4099 to 1.4096	1.4113
at 14.6° C.	

## Viscosity (centipoises):

3.31 at 25° C.	1.33 at 60° C.
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Inflammability Range (volume per cent in air): 1.2 (lower limit)

## Flash Point:

120° F.	91° F. (closed)
136° F. (open)	

Specific Heat (gram-calories per g. per ° C.): 0.712 (liquid)

Heat of Vaporization (gram-calories per g.)

120.6	102.5
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## Uses:

organic synthesis	extraction of
pharmaceutical	rosin from wood
products	

solvent in: manufacture of lacquers, varnishes, cellulose acetate compositions, raw cotton purification

Solubility (grams per 100 ml.):

2.7 at 22° C.	∞ (in alcohol)
(in water)	∞ (in ether)

soluble in: acetone, benzene, methyl alcohol, gasoline, and ethyl acetate

## Additional Data:

autoignition temperature, 621° F.  
vapor density, 3.04  
coefficient of thermal expansion,  
0.00092 per ° C.  
miscible with many organic solvents  
fire point (open cup), 136° F.

## AMYL ALCOHOL

(Mixed isomers 99% pure)

Formula:  $\text{C}_5\text{H}_{11}\text{OH}$ 

Formula Weight: 88.2

## Boiling Point:

121 to 139° C. (at 760 mm.)

Specific Gravity: 0.814 at 20° C.

6.77 lbs. per gal.

Flash Point: 111° F. (closed)

Solubility (grams per 100 ml.):

8.98 (of water)	0.09 (in water)
-----------------	-----------------

Additional Data: coefficient of expansion,  
0.00093 per ° C.tert-AMYL ALCOHOL

## Synonyms:

amylene hydrate	2-methyl-
dimethylethyl	2-butanol
carbinol	

Formula:  $(\text{CH}_3)_2\text{COHC}_2\text{H}_5$ 

## Characteristics:

characteristic odor burning taste

Formula Weight: 88.2

## Boiling Point:

102° C.	99.5 to 103° C.
(at 760 mm.)	(at 760 mm.)

## Melting Point:

-11.9° C.	-18 to -11° C.
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## Specific Gravity:

0.809(20/4)                      0.81(20/20)  
6.75 lbs. per gal.

Refractive Index: 1.4052

## Viscosity (centipoises):

3.70 at 25° C.                      0.99 at 63° C.

## Flash Point:

65 to 70° F. (open)    20° F. (closed)

Specific Heat (gram-calories per g.  
 per ° C.): 0.753 (liquid)

Heat of Vaporization (gram-calories  
 per g.): 106.2

Heat of Fusion (gram-calories per g.):  
 12.5 at 15° C.

## Uses:

solvent in the manufacture of:  
 chemicals, various cellulose esters  
 and ethers, dopes, surface coatings  
 lacquers and varnishes, dry clean-  
 ing mixtures  
 hypnotic sedative

## Solubility (grams per 100 ml.):

14 at 30° C. (in water)  
 soluble in: alcohol, ether, chloroform,  
 benzene, and glycerine

## Additional Data:

soluble in oils  
 coefficient of expansion, 0.00133  
 per ° C.  
 should be stored in tightly closed con-  
 tainers and away from the light

## AMYLAMINE

## Synonyms:

1-aminopentane                      pentylamine

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{NH}_2$

Characteristics: ammoniacal

Formula Weight: 87.2

Melting Point: -55° C.

## Boiling Point:

103 to 104° C. (at 760 mm.)

## Specific Gravity:

0.766 at 19° C.                      0.7614(20/4)

Flash Point: 65° F. (closed)

## Solubility:

very soluble in                      soluble in alcohol  
 water                                      ∞ (in ether)  
 soluble in: acetone, benzene, methyl  
 alcohol, gasoline, and ethyl acetate

Additional Data: coefficient of expansion,  
0.0016 at 20 to 60° C.

## AMYLAMINE

(Commercial mixture at least 90%  
 amylamine)

Formula:  $\text{C}_5\text{H}_{11}\text{NH}_2$

Characteristics: ammoniacal

Formula Weight: 87.2

## Boiling Point:

84 to 110° C. (at 760 mm.)

Specific Gravity: 0.76 to 0.78(20/20)

6.41 lbs. per gal.

Refractive Index: 1.417

Surface Tension (dynes per cm.):

24.4 at 13° C.

Viscosity (centipoises): 1.02 at 20° C.

Flash Point: 65° F. (closed)

Specific Heat (gram-calories per g.  
 per ° C.):

0.65 at room temperature

Heat of Vaporization (gram-calories  
 per g.): 108

## Uses:

organic synthesis of: antioxidants,  
 dyes, desizing agents, emulsifying  
 agents

## Solubility:

soluble in: water, methyl alcohol,  
 ether, acetone, benzene, gasoline,  
 and ethyl acetate

## Additional Data:

pH of Aqueous Solution of 25° C.

Normality	pH	Normality	pH
1.0 . . . .	12.25	0.05 . . . .	11.65
0.5 . . . .	12.21	0.01 . . . .	11.26
0.1 . . . .	11.84	0.001 . . .	10.50

sec-AMYLAMINE

## Synonyms:

2-aminopentane  
d-methylbutylamine  
 methylpropylcarbinylamine

## Formula:



Characteristics: ammoniacal

Formula Weight: 87.2

Melting Point:  $< -65^\circ\text{C}$ .

## Boiling Point:

91 to $92^\circ\text{C}$ .	89 to $92^\circ\text{C}$ .
(at 760 mm.)	(at 760 mm.)

## Specific Gravity:

0.749(20/4)	0.73839(20/0)
0.741(20/20)	

Refractive Index: 1.3950 at  $16.5^\circ\text{C}$ .Viscosity (centipoises): 0.55Flash Point:  $20^\circ\text{F}$ . (closed)

## Solubility:

$\infty$  (in water)                       $\infty$  (in ether)  
 $\infty$  (in alcohol)  
 soluble in: acetone, benzene, gasoline,  
 ethyl acetate, and methyl alcohol

tert-AMYLAMINE

## Synonyms:

dimethylethylcarbinylamine  
 (*d*, *d*-dimethylpropylamine)

Formula:  $\text{C}_2\text{H}_5\text{C}(\text{CH}_3)_2\text{NH}_2$ 

Characteristics: ammoniacal

Formula Weight: 87.2

Melting Point:  $-105^\circ\text{C}$ .Boiling Point: 77 to  $78.5^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

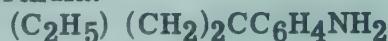
0.731(25/4)	0.7611(0/4)
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## Solubility:

$\infty$ (in water)	$\infty$ (in ether)
$\infty$ (in alcohol)	$\infty$ (in chloroform)

p-tert-AMYLANILINE

## Formula:



## Characteristics:

amber	aniline-like odor
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Formula Weight: 163.3

Melting Point:  $< -50^\circ\text{C}$ .

## Boiling Point:

259 to $262^\circ\text{C}$ .	251 to $260^\circ\text{C}$ .
(at 760 mm.)	(at 760 mm.)

Specific Gravity: 0.948(20/20)

Refractive Index: 1.538

Viscosity (centipoises): 10.4 at  $25^\circ\text{C}$ .Flash Point:  $215^\circ\text{F}$ . (closed)

## Solubility:

insoluble in water  
 soluble in: alcohol, ether, acetone,  
 benzene, gasoline, methanol, and  
 ethyl acetate

Additional Data: coefficient of expansion,  
0.00080 per  $^\circ\text{C}$ .

## AMYL BENZENE

Synonyms: 1-phenylpentane

Formula:  $\text{C}_6\text{H}_5(\text{CH}_2)_4\text{CH}_3$ 

Formula Weight: 148.2

Melting Point:  $-78.3^\circ\text{C}$ .

## Boiling Point:

202.1 $^\circ\text{C}$ .	185 to $198^\circ\text{C}$ .
(at 760 mm.)	(at 760 mm.)

## Specific Gravity:

0.858(20/4)	0.860(22/4)
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## Refractive Index:

1.4751 at $15^\circ\text{C}$ .	1.488
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Viscosity (centipoises): 1.21 at  $20^\circ\text{C}$ .Flash Point:  $150^\circ\text{F}$ . (closed)

## Solubility:

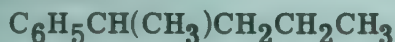
insoluble in water     $\infty$  (in ether)  
 $\infty$  (in alcohol)  
 soluble in: acetone, benzene, gasoline  
 and ethyl acetate

sec-AMYL BENZENE

## Synonyms:

$\alpha$ -methylbutyl- 2-phenylpentane  
benzene

## Formula:



Formula Weight: 148.2

## Boiling Point:

189.3 to 193°C. (at 760 mm.)

Specific Gravity: 0.874(15/4)

## Solubility:

insoluble in water    soluble in ether  
soluble in alcohol

tert-AMYL BENZENE

## Synonyms:

dimethylethylphenylmethane  
2-methyl-2-phenylbutane

Formula:  $\text{C}_6\text{H}_5\text{C}(\text{CH}_3)_2\text{C}_2\text{H}_5$ 

Formula Weight: 148.2

## Boiling Point:

189 to 191°C. (at 760 mm.)

## Specific Gravity:

0.867(20/4)                      0.8736 at 15°C.

Refractive Index: 1.4915 at 23°C.

## Solubility:

insoluble in water     $\infty$  (in ether)  
 $\infty$  (in alcohol)

## AMYL BENZOATE

Synonyms: benzoic acid amyl ester

Formula:  $\text{C}_6\text{H}_5\text{COOC}_5\text{H}_{11}$ 

## Characteristics:

light straw color    faintly aromatic  
odor

Formula Weight: 192.1

Boiling Point: 216 to 225°C. (at 760 mm.)

Specific Gravity: 0.988(20/20)

## AMYL BENZYL ETHER

Synonyms: benzyl amyl ether

Formula:  $\text{C}_5\text{H}_{11}\text{OCH}_2\text{C}_6\text{H}_5$ 

Characteristics: ethereal odor

Formula Weight: 178.3

Melting Point: -61°C.

Boiling Point: 224 to 239°C. (at 760 mm.)

Specific Gravity: 0.910(20/20)

Refractive Index: 1.485

Viscosity (centipoises): 2.00 at 20°C.

Additional Data: coefficient of expansion,  
0.00033 per °C.

## AMYL BORATE

Synonyms: triamyl borate

Formula:  $\text{B}(\text{C}_5\text{H}_{11}\text{O})_3$ 

## Characteristics:

light straw color    alcoholic odor

Formula Weight: 272.2

Melting Point: &lt; -50°C.

## Boiling Point:

130 to 132°C.                      240 to 265°C.  
(at 6 mm.)                      (at 760 mm.)

Specific Gravity: 0.855(20/20)

Viscosity (centipoises): 2.70 at 20°C.

## Uses:

solvent for oils and resins

## Additional Data:

coefficient of expansion, 0.00126  
per °C.  
miscible with most lacquers and  
dilutents

## AMYLBIIPHENYL

## Synonyms:

monoamyl biphenyl    Pentaryl A

Formula:  $\text{C}_5\text{H}_{11}\text{C}_6\text{H}_4\text{CH}_3$ 

Characteristics: faint odor

AMYLBIIPHENYL (Cont.)

Formula Weight: 224.3

Melting Point:  $-60^{\circ}\text{C}$ .

Boiling Point:  $314$  to  $338^{\circ}\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity:  $0.968(20/20)$

Refractive Index:  $1.566$

Viscosity (centipoises):  $21.0$  at  $20^{\circ}\text{C}$ .

Solubility:

insoluble in water insoluble in methyl alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

Additional Data: coefficient of expansion,  
 $0.00091$  per  $^{\circ}\text{C}$ .

AMYL BUTYRATE

Synonyms:

butyric acid amyl ester pentyl butanoate

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{COOC}_5\text{H}_{11}$

Formula Weight: 158.2

Melting Point:  $-73.2^{\circ}\text{C}$ .

Boiling Point:  $185^{\circ}\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity:  $0.8713(15/4)$

Refractive Index:  $1.4110$

Viscosity (centipoises):  $1.2558$  at  $25^{\circ}\text{C}$ .

Solubility (grams per 100 ml.):

$0.05$  at  $20^{\circ}\text{C}$ .  $\infty$  (in alcohol)  
(in water)  $\infty$  (in ether)

Uses:

solvent cellulose ether  
plasticizer for plastics  
cellulose acetate

tert-AMYL BUTYRATE

Synonyms:

butyric acid tert-butyl ester

Formula:

$\text{CH}_3(\text{CH}_2)_2\text{COO}(\text{CH}_2)_4\text{CH}_3$

Formula Weight: 158.2

Boiling Point:  $164^{\circ}\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity:  $0.865(14.5/4)$

Solubility:

slightly soluble  $\infty$  (in alcohol)  
in water  $\infty$  (in ether)

AMYL CAPROATE

Synonyms:

caproic acid pentyl  
amyl ester hexanoate

Formula:

$\text{CH}_3(\text{CH}_2)_4\text{COO}(\text{CH}_2)_4\text{CH}_3$

Formula Weight: 186.3

Boiling Point:  $222$  to  $227^{\circ}\text{C}$ . (at  $760\text{ mm.}$ )

AMYL CARBONATE

Synonyms:

carbonic acid diamyl carbonate  
amyl ester

Formula:  $(\text{C}_5\text{H}_{11}\text{O})_2\text{CO}$

Formula Weight: 202.3

Boiling Point:  $130$  to  $132^{\circ}\text{C}$ . (at  $20\text{ mm.}$ )

AMYL CHLOROFORMATE

Synonyms: n-amylchlorocarbonate

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{OCOCl}$

Formula Weight: 150.6

Boiling Point:  $43$  to  $45^{\circ}\text{C}$ . (at  $2\text{ mm.}$ )

$\alpha$ -AMYL CINNAMYLALDEHYDE

Formula:

$\text{C}_6\text{H}_5\text{CH}:\text{C}(\text{C}_5\text{H}_{11})\text{CHO}$

Characteristics: yellow

Formula Weight: 202.3

Boiling Point:  $163$  to  $168^{\circ}\text{C}$ . (at  $15\text{ mm.}$ )

p-tert-AMYL-o-CRESOL

Formula:  $\text{C}_5\text{H}_{11}\text{C}_6\text{H}_3(\text{CH}_3)\text{OH}$

**Characteristics:**

straw color                      phenolic odor

**Formula Weight:** 178.3**Melting Point:** 15° C.**Boiling Point:** 260 to 261° C. (at 760 mm.)**Specific Gravity:** 0.969(20/20)**Refractive Index:** 1.524**Viscosity (centipoises):** 75 at 25° C.**Flash Point:** 240° F. (closed)**Solubility:**insoluble in water      soluble in ether  
soluble in alcohol**Additional Data:** coefficient of expansion,  
0.00083 per ° C.**AMYL ETHER****Synonyms:**amyl oxide                      diamyl ether  
amylic ether                      pentyloxy pentane**Formula:**  $[\text{CH}_3(\text{CH}_2)_3\text{CH}_2]_2\text{O}$ **Characteristics:**colorless to yellow      inflammable  
unpleasant odor**Formula Weight:** 158.3**Melting Point:** -69.3° C.**Boiling Point:** 190° C. (at 760 mm.)**Specific Gravity:** 0.774(20/4)**Heat of Vaporization (gram-calories per g.):** 69.5 at 15° C.**Solubility:** insoluble in water $\infty$  (in alcohol)                       $\infty$  (in ether)**4-tert-AMYL CYCLOHEXANOL****Formula:**  $\text{C}_5\text{H}_{11}\text{C}_6\text{H}_{10}\text{OH}$ **Characteristics:** ethereal odor**Formula Weight:** 170.3**Melting Point:** 15 to 17° C.**Boiling Point:** 244 to 250° C. (at 760 mm.)**Specific Gravity:** 0.919(20/20)**Refractive Index:** 1.476**Viscosity (centipoises):** 420 at 25° C.**Solubility:** insoluble in watersoluble in methanol, acetone, benzene,  
gasoline, and ethyl acetate**Additional Data:** coefficient of expansion,  
0.00086 per ° C.**AMYL ETHER****Synonyms:** chiefly a mixture of thenormal and iso compound plus small  
amounts of diamylene and isomeric  
amyl ethers**Formula:**  $(\text{C}_5\text{H}_{11})_2\text{O}$ **Characteristics:** clear to pale yellow**Melting Point:** < -75° C.**Boiling Point:** 165 to 210° C. (at 760 mm.)**Vapor Pressure (mm. Hg.):** 0.67**Specific Gravity:**0.78 to 0.80(20/20)6.61 lbs. per gal.**Refractive Index:** 1.42**Surface Tension (dynes per cm.):** 24.8**Flash Point:** 135° F. (open)**Specific Heat (gram-calories per g. per ° C.):** 0.513 (liquid)**Heat of Vaporization (gram-calories per g.):** 65.9**Uses:**

solvent of ethyl cellulose

**AMYL DISULFIDE****Synonyms:** diamyl disulfide**Formula:**  $(\text{C}_5\text{H}_{11}\text{S})_2$ **Characteristics:** yellow**Formula Weight:** 206.4**Boiling Point:** 128 to 130° C. (at 12 mm.)

AMYL ETHER (Cont.)

Solubility: insoluble in water  
soluble in: methyl alcohol, ether,  
acetone, benzene, gasoline, ethyl  
acetate

Additional Data:

water azeotrope at 96 to 98° C. con-  
tains 41% of amyl ether  
dielectric constant, 3.14  
Kauri butanol value, 68

AMYL ETHYL ETHER

Synonyms:

ethyl amyl ether      ethoxypentane

Formula:  $C_2H_5O(CH_2)_4CH_3$

Formula Weight: 116.2

Boiling Point: 119 to 120° C. (at 760 mm.)

Specific Gravity: 0.759(18/4)

Solubility:

slightly soluble      ∞ (in alcohol)  
in water      ∞ (in ether)

AMYL FORMATE

Synonyms:

formic acid      pentyl methanoate  
amyl ester

Formula:  $HCOO(CH_2)_4CH_3$

Formula Weight: 116.2

Melting Point: -73.5° C.

Boiling Point: 130.6° C. (at 760 mm.)

Specific Gravity:

0.902 at 0° C.      0.8926(15/4)

Refractive Index: 1.395 at 11.5° C.

Solubility:

very slightly sol-      ∞ (in alcohol)  
uble in water      ∞ (in ether)

AMYL FUROATE

Synonyms: furoic acid amyl ester

Formula:

$C_4H_3OCOO(CH_2)_4CH_3$

Formula Weight: 182.1

Boiling Point: 95 to 97° C. (at 1 mm.)

Specific Gravity: 1.0335

Solubility:

insoluble in water      ∞ (in alcohol)

AMYL  $\beta$ -FURYLACRYLATE

Formula:

$C_4H_3CH:CHCOO(CH_2)_4CH_3$

Formula Weight: 208.3

Boiling Point: 119° C. (at 4 mm.)

Specific Gravity: 1.032(20/6)

Solubility: insoluble in water

AMYL ISOBUTYRATE

Synonyms:

isobutyric acid      pentyl 2-methyl  
amyl ester      propanoate

Formula:  $(CH_3)_2CHCOO(CH_2)_4CH_3$

Formula Weight: 158.2

Boiling Point: 155° C. (at 760 mm.)

Specific Gravity: 0.8592 at 13° C.

Refractive Index: 1.4076

Solubility: slightly soluble in water  
∞ (in alcohol)      ∞ (in ether)

AMYL ISOCYANIDE

Synonyms: n-amylcarbylamine

Formula:  $CH_3(CH_2)_4NC$

Formula Weight: 97.2

Melting Point: -51.1° C.

Boiling Point: 155.5° C. (at 760 mm.)

Specific Gravity: 0.806(20/4)

Solubility:

insoluble in water      soluble in alcohol

AMYL ISOTHIOCYANATE

Synonyms: amyl mustard oil  
Formula:  $\text{CH}_3(\text{CH}_2)_4\text{NCS}$   
Formula Weight: 129.2  
Boiling Point: 193.4° C. (at 760 mm.)  
Solubility:  
    very slightly sol-      very soluble in  
    uble in water          ether  
    very soluble in  
    alcohol

tert-AMYL ISOTHIOCYANATE

Formula:  $(\text{CH}_3)_3\text{CCH}_2\text{NCS}$   
Formula Weight: 129.2  
Melting Point: < -10° C.  
Boiling Point: 166° C. (at 770 mm.)  
Solubility:  
    very slightly sol-      very soluble in  
    uble in water          ether  
    very soluble in  
    alcohol

tert-AMYL ISOVALERATE

Synonyms: valamin  
Formula:  
     $(\text{CH}_3)_2\text{CHCH}_2\text{COOC}(\text{C}_2\text{H}_5)(\text{CH}_3)_2$   
Characteristics: valerian odor and taste  
Formula Weight: 172.3  
Boiling Point: 173 to 174° C. (at 760 mm.)  
Specific Gravity: 0.861(14/4)  
Solubility:  
    slightly soluble      soluble in alcohol  
    in water              soluble in oils

AMYL LACTATE

Synonyms:  
    lactic acid amyl ester  
Formula:  
     $\text{C}_2\text{H}_5\text{OCOOCH}_2\text{CH}(\text{CH}_3)\text{C}_2\text{H}_5$

Characteristics:  
    colorless to pale      alcoholic odor  
    yellow  
    straw color  
Formula Weight: 160.2  
Boiling Point:  
    114 to 115° C.      75 to 150° C.  
    (at 36 mm.)          (at 20 mm.)  
Specific Gravity:  
    0.971(20/4)          0.960(20/20)  
Flash Point: 175° F. (closed)  
Solubility:  
    very slightly sol-      soluble in alcohol  
    uble in water          soluble in ether

AMYL LAURATE

Synonyms: lauric acid amyl ester  
Formula:  $\text{C}_{11}\text{H}_{23}\text{COOC}_5\text{H}_{11}$   
Characteristics:  
    light straw color      alcoholic odor  
Formula Weight: 270.4  
Melting Point: -17° C.  
Boiling Point: 290 to 330° C. (at 760 mm.)  
Specific Gravity: 0.858(20/20)  
Refractive Index: 1.438  
Viscosity (centipoises): 5.28  
Flash Point: 300° F. (closed)

AMYL MALEATE

Synonyms:  
    diamyl maleate      maleic acid  
                                amyl ester  
Formula:  $(\text{CHCOOC}_5\text{H}_{11})_2$   
Characteristics: alcoholic odor  
Formula Weight: 256.3  
Melting Point: -50° C.  
Boiling Point: 270 to 315° C. (at 760 mm.)  
Vapor Pressure (mm. Hg): 7.46 at 25° C.  
Specific Gravity: 0.972(20/20)

AMYL MALEATE (Cont.)

Refractive Index: 1.446

Flash Point: 270° F. (closed)

Additional Data: coefficient of expansion,  
0.00083 per °C.

AMYL MERCAPTAN

Synonyms: a commercial mixture of  
various amyl isomers, mercaptan con-  
tent at least 90%. For individual  
compounds see under individual names.

Formula:  $C_5H_{11}SH$

Characteristics:  
colorless to pale      mercaptan odor  
yellow

Boiling Point: 104 to 130° C. (at 760 mm.)

Specific Gravity:  
0.83 to 0.84(20/20)  
6.99 lbs. per gal.

Refractive Index: 1.441

Surface Tension (dynes per cm.):  
24.6 at 13° C.

Viscosity (centipoises): 0.556

Flash Point: 65° F. (open)

Specific Heat (gram-calories per g.  
per °C.):  
0.48 at room temperature (liquid)

Heat of Vaporization (gram-calories  
per g.): 78

Uses:  
chief constituent of "Pentalarm"  
chemical synthesis of: amylsulfonic  
acids, sulfonals, sulfoxides

Solubility: insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

Additional Data: coefficient of expansion,  
0.00110 per °C.

sec-AMYL MERCAPTAN

Formula:  $C_5H_{11}SH$

Characteristics: mercaptan odor

Formula Weight: 104.2

Freezing Point: <-60° C.

Boiling Point: 105 to 113° C. (at 760 mm.)

Specific Gravity: 0.834(20/20)

Refractive Index: 1.442

Viscosity (centipoises): 0.58

Flash Point: 55° F. (closed)

Solubility: insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

AMYL METHYL ETHER

Synonyms:  
1-methoxypentane      methyl amyl ether

Formula:  $CH_3(CH_2)_4OCH_3$

Formula Weight: 102.2

Boiling Point:  
88.5° C.      99 to 100° C.  
(at 760 mm.)      (at 760 mm.)

Specific Gravity: 0.754

AMYLNAPHTHALENE

Synonyms:  
monoamyl-      Pentalene 103  
naphthalene

Formula:  $C_{10}H_7C_5H_{11}$

Characteristics:  
viscous      oily  
toxic      amber color

Formula Weight: 198.3

Freezing Point: -60° C.

Specific Gravity:  
0.96 to 0.97(20/20)      0.934(60/15)  
8.04 lbs. per gal.

Refractive Index: 1.573

Viscosity (centipoises):

10.1 at 20° C.      8.25 at 25° C.

Flash Point: 255° F. (open)

Specific Heat (gram-calories per g. per ° C.): 0.41 (liquid)

Heat of Vaporization (gram-calories per g.): 64.3

Uses:

solvent of DDT      heat transfer  
coupling agent      medium

Solubility:

insoluble in water      insoluble in  
   methyl alcohol  
soluble in: ether, acetone, benzene,  
and ethyl acetate

Additional Data:

neutral      relatively stable  
nonsaponifiable  
miscible with most organic solvents  
coefficient of expansion, 0.00077  
per ° C.

#### AMYLNAPHTHALENE (crude)

Synonyms: Pentalene 95, an undistilled reaction product containing monoamyl, diamyl and polyamyl naphthalene derivatives

Characteristics:

viscous      faint naphtha-  
dark green to      lene odor  
brown

Formula Weight: 231 to 256

Freezing Point: -36° C.

Boiling Point:

<250 to >400° C. (at 760 mm.)

Specific Gravity: 0.94 to 0.96(20/20)  
7.89 lbs. per gal.

Refractive Index: 1.552

Viscosity (centipoises): 112 at 20° C.

Flash Point: 250° F. (open)

Solubility:

insoluble in water      insoluble in  
   methyl alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

#### AMYLNAPHTHALENE (mixed)

Synonyms: Pentalene 195, a distilled mixture of mono, di, and polyamyl-naphthalenes

Characteristics:

viscous      amber color

Boiling Point: 290 to 600° C. (at 760 mm.)

Specific Gravity: 0.92 to 0.94(20/20)  
7.75 lbs. per gal.

Flash Point: 300° F. (open)

Uses:

anionic surface active agent

Solubility:

insoluble in water      insoluble in  
   methyl alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

#### AMYLNAPHTHALENE (poly)

Synonyms:

Pentalene 92, a commercial mixture

Characteristics:

stable      unsaponifiable  
neutral      viscous  
dark amber

Melting Point: -45° C.

Boiling Point: 353 to 397° C. (at 760 mm.)

Specific Gravity:

0.902(60/15)      0.92 to 0.93 at  
   30° C.  
7.72 lbs. per gal.

Refractive Index: 1.545

Viscosity (in centipoises):

1064 at 20° C.      658.3 at 25° C.

Flash Point: 360° F. (open)

AMYLNAPHTHALENE (poly)(Cont.)

Uses:

plasticizer for	heat transfer
dark resins	medium
coupling agent	surface active agent

Additional Data: coefficient of expansion,  
0.0089 per °C.

AMYL NITRATE (mixed isomers)

Formula:  $C_5H_{11}NO_3$

Characteristics: ethereal odor

Formula Weight: 133.2

Melting Point: <-60° C.

Boiling Point: 145 to 156° C. (at 760 mm.)

Specific Gravity:

0.990 at 20° C.      0.997 at 25° C.

Refractive Index: 1.414 at 20° C.

Viscosity (centipoises): 0.98 at 25° C.

Flash Point: 118° F. (closed)

Additional Data: coefficient of expansion,  
0.00117 per °C.

AMYL NITRITE

Synonyms: pentyl nitrite

Formula:  $CH_3(CH_2)_4ONO$

Characteristics: pale yellow

Formula Weight: 117.2

Boiling Point: 104° C. (at 760 mm.)

Specific Gravity: 0.8528(20/4)

Refractive Index: 1.385

Solubility:

slightly soluble	∞ (in alcohol)
in water	∞ (in ether)

AMYL OLEATE

Synonyms: oleic acid amyl ester

Formula:  $C_{17}H_{33}COOC_5H_{11}$

Characteristics:

light straw color      alcoholic odor

Formula Weight: 325.6

Melting Point: <-40° C.

Boiling Point: 200 to 240° C. (at 20 mm.)

Specific Gravity: 0.862(20/20)

Refractive Index: 1.465 at 20° C.

Viscosity (centipoises): 9.4 at 25° C.

Flash Point: 366° F. (closed)

Additional Data: coefficient of expansion,  
0.00129 per °C.

AMYL ORTHOFORMATE

Formula:  $HC(OC_5H_{11})_3$

Formula Weight: 274.4

Boiling Point:

265 to 267° C. (at 760 mm.)  
decomposition

Specific Gravity: 0.864 at 23° C.

AMYL OXALATE

Synonyms:

diamyl oxalate	oxalic acid
	amyl ester

Formula:  $(COOC_5H_{11})_2$

Characteristics:

pale straw color      alcoholic odor

Formula Weight: 230.3

Melting Point: <-70° C.

Boiling Point:

<u>240 to 273° C.</u>	<u>133 to 155° C.</u>
(at 760 mm.)	(at 25 mm.)

Specific Gravity: 0.963(20/20)

Refractive Index: 1.427

Viscosity (centipoises): 3.95 at 25° C.

Flash Point: 245° F. (closed)

o-sec-AMYLPHENOL

Synonyms: Orthophen 206  
Formula:  $C_5H_{11}C_6H_4OH$   
Characteristics: light straw color phenolic odor  
Formula Weight: 164.2  
Melting Point: 290° C.  
Boiling Point: 235 to 250° C. (at 760 mm.)  
Specific Gravity: 0.963(20/20)  
Refractive Index: 1.516  
Flash Point: 200° C. (closed)  
Uses: antiskinning agent for paints, varnishes and oleo-resin enamels  
Solubility: insoluble in water  
soluble in methyl alcohol, ether, oils, acetone, benzene, common organic solvents, gasoline, and ethyl acetate

o-tert-AMYLPHENOL

Synonyms: Orthophen 85  
Formula:  $C_5H_{11}C_6H_4OH$   
Characteristics: clear pale yellow  
Formula Weight: 164.2  
Boiling Point: 233 to 245° C. (at 760 mm.)  
Specific Gravity: 0.96 to 0.97 at 30° C.  
8.12 lbs. per gal.  
Flash Point: 219° F. (open)  
Uses: antiskinning agent for paints, varnishes and oleo-resin enamels  
Solubility: very slightly soluble in water  
soluble in oil  
very soluble in 10% potassium hydroxide  
soluble in common organic solvents  
Additional Data: fire point, 241° F.

p-sec-AMYLPHENOL

Formula:  $C_5H_{11}C_6H_4OH$   
Characteristics: light straw color phenolic odor  
Formula Weight: 164.2  
Melting Point: 1° C.  
Boiling Point: 250 to 269° C. (at 760 mm.)  
Specific Gravity: 0.958(20/20)  
Refractive Index: 1.517  
Flash Point: 270° F. (closed)  
Solubility: insoluble in water  
soluble in methyl alcohol, ether, acetone, benzene, gasoline, and ethyl acetate

tert-p-AMYLPHENOL METHYL ETHER

Formula:  $(C_2H_5)(CH_3)_2CC_6H_4OCH_3$   
Formula Weight: 178.3  
Boiling Point: 216 to 217° C. (at 760 mm.)  
Solubility: insoluble in water  
soluble in alcohol, and ether

p-tert-AMYLPHENOXYETHANOL

Formula:  $C_5H_{11}C_6H_4OCH_2CH_2OH$   
Characteristics: faint odor  
Formula Weight: 208.3  
Melting Point: -55° C.  
Boiling Point: 297 to 310° C. (at 760 mm.)  
Specific Gravity: 1.018(20/20)  
Refractive Index: 1.519  
Viscosity (centipoises): 95 at 25° C.  
Flash Point: 280° F. (closed)

## p-tert-AMYLPHENOXYETHANOL (Cont.)

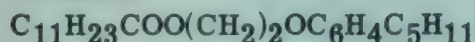
## Solubility:

insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and ethyl  
acetate.

Additional Data: coefficient of expansion,  
0.0077 per °C.

p-tert-AMYLPHENOXYETHYL  
LAURATE

## Formula:



## Characteristics:

faint odor                      pale straw color

Formula Weight: 390.6

Melting Point: 10° C.

Boiling Point: 240 to 260° C. (at 6 mm.)

Specific Gravity: 0.947(20/20)

Refractive Index: 1.487

Viscosity (centipoises): 40 at 25° C.

Flash Point: 410° F. (closed)

Additional Data: coefficient of expansion,  
0.00094 per °C.

## p-tert-AMYLPHENYL ACETATE



Characteristics: fruity odor

Formula Weight: 206.3

Melting Point: 9.5° C.

Boiling Point: 264 to 266° C. (at 760 mm.)

Specific Gravity: 0.994(20/20)

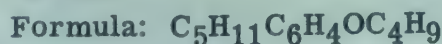
Refractive Index: 1.500

Viscosity (centipoises): 12 at 25° C.

Flash Point: 240° F. (closed)

Additional Data: coefficient of expansion,  
0.00089 per °C.

## p-tert-AMYLPHENYL BUTYL ETHER



Characteristics: pale straw color

Formula Weight: 220.2

Melting Point: -18° C.

Boiling Point: 282 to 288° C. (at 760 mm)

Specific Gravity: 0.917(20/20)

Refractive Index: 1.496

Viscosity (centipoises): 6.41 at 25° C.

Flash Point: 275° F. (closed)

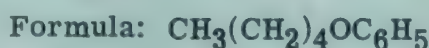
## Solubility:

insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

Additional Data: coefficient of expansion  
0.00097 per °C.

## AMYL PHENYL ETHER

Synonyms: amoxybenzene



## Characteristics:

pale straw color              aromatic odor

Formula Weight: 164.2

Melting Point: -45° C.

Boiling Point:

111° C.                      216 to 229° C.  
(at 17 mm.)                      (at 760 mm.)

Specific Gravity: 0.922(20/20)

Refractive Index: 1.493

Viscosity (centipoises): 2.02 at 25° C.

Flash Point: 185° F. (closed)

## Solubility:

insoluble in water      soluble in ether  
soluble in ethyl  
alcohol

Additional Data: coefficient of expansion  
0.00086 per °C.

p-tert-AMYLPHENYL  
METHYL ETHER

Formula:  $C_5H_{11}C_6H_4OCH_3$

Characteristics: faint aromatic odor

Formula Weight: 178.3

Melting Point:  $-12^{\circ}C$ .

Boiling Point:  $239$  to  $243^{\circ}C$ . (at 760 mm.)

Specific Gravity:  $0.940(20/20)$

Refractive Index:  $1.506$

Viscosity (centipoises):  $3.24$  at  $25^{\circ}C$ .

Flash Point:  $210^{\circ}F$ . (closed)

Additional Data: coefficient of expansion,  
 $0.00077$  per  $^{\circ}C$ .

AMYL PROPIONATE

Synonyms:

pentyl propanoate      propionic acid  
amyl ester

Formula:

$C_2H_5COO(CH_2)_4CH_3$

Formula Weight: 144.2

Melting Point:  $-73.1^{\circ}C$ .

Boiling Point:

$164$  to  $168.7^{\circ}C$ . (at 760 mm.)

Specific Gravity:  $0.8761(15/4)$

Solubility:

insoluble in       $\infty$  (in alcohol)  
water       $\infty$  (in ether)

act-AMYL PROPIONATE

Synonyms:

$\gamma$ -methylbutyl propanoate  
propionic acid act-amyl ester

Formula:  $C_2H_5COOC_5H_{11}$

Formula Weight: 144.2

Boiling Point:  $58^{\circ}C$ . (at 16 mm.)

Specific Gravity:  $0.866(20/4)$

Solubility:

very slightly sol-       $\infty$  (in alcohol)  
uble in water       $\infty$  (in ether)

AMYL SALICYLATE

Synonyms:

pentyl o-hydroxybenzoate  
salicylic acid amyl ester

Formula:

$HOC_6H_4COO(CH_2)_4CH_3$

Characteristics: pale yellow

Formula Weight: 208.3

Boiling Point:  $265^{\circ}C$ . (at 760 mm.)

Specific Gravity:  $1.065$  at  $15^{\circ}C$ .

Flash Point:  $270^{\circ}F$ . (closed)

Solubility:

insoluble in       $\infty$  (in alcohol)  
water       $\infty$  (in ether)

Additional Data: vapor density,  $7.17$

act-AMYL STEARATE

Synonyms:

stearic acid act-amyl ester

Formula:

$C_{17}H_{35}COOCH_2CH(CH_3)C_2H_5$

Formula Weight: 354.6

Melting Point:  $21$  to  $22^{\circ}C$ .

Specific Gravity:  $0.855(20/4)$

Solubility: insoluble in water

soluble in alcohol      soluble in ether

AMYL SUCCINATE

Synonyms:

amyl butanedioate      succinic acid  
diamyl succinate      amyl ester

Formula:  $(CH_2COOC_5H_{11})_2$

Characteristics: pleasant aromatic odor

Formula Weight: 258.4

Melting Point:  $-9^{\circ}C$ .

AMYL SUCCINATE (Cont.)

Boiling Point: 172°C. ( at 16 mm.)

Specific Gravity: 0.9613

Refractive Index: 1.4355

Uses:

flavor in alcoholic beverage  
formulations

act-AMYL SUCCINATE

Synonyms:

act-amyl butanedioate  
di-act-amyl succinate  
succinic acid act-amyl ester

Formula Weight: 258.4

Boiling Point: 178 to 180°C. (at 25 mm.)

Specific Gravity: 0.959(20/4)

Solubility: insoluble in water  
soluble in alcohol soluble in ether

AMYL SULFATE

Synonyms:

diamyl sulfate pentyl sulfate

Formula:  $[\text{CH}_3(\text{CH}_2)_4]_2\text{SO}_4$

Formula Weight: 238.3

Boiling Point: 117.0 (at 25 mm.)

Specific Gravity: 1.0265(25/25)

Refractive Index: 1.4270 at 25°C.

Solubility: insoluble in water  
soluble in alcohol soluble in ether

AMYL SULFIDE

Synonyms:

diamyl sulfide, commercial grade is  
a mixture of isomers

Formula:  $[\text{CH}_3(\text{CH}_2)_4]_2\text{S}$

Characteristics: yellow

Formula Weight: 174.3

Boiling Point:

103 to 105°C. 170 to 280°C.  
(at 12 mm.) (at 760 mm.)

Specific Gravity:

0.85 to 0.91(20/20)  
7.52 lbs. per gal.

Refractive Index: 1.4774 at 19°C.

Surface Tension (dynes per cm.):  
27.3 at 13°C.

Viscosity (centipoises): 1.777 at 20°C.

Flash Point: 185°F. (open)

Specific Heat (gram-calories per g.  
per °C.):

0.46 at room temperature

Uses:

organic sulfur compounds sulfones and sulf  
derivatives

Solubility:

insoluble in water insoluble in meth  
alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

Additional Data: coefficient of expansion  
0.00090 per °C.

AMYL SULFITE

Synonyms: diamyl sulfite

Formula:  $(\text{C}_5\text{H}_{11}\text{O})_2\text{SO}$

Formula Weight: 222.3

Boiling Point: 136 to 138°C. (at 15 mm.)

AMYL TOLUENE

Synonyms: m-methylamylbenzene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{C}_5\text{H}_{11}$

Characteristics:

pale straw color aromatic odor

Formula Weight: 162.3

Boiling Point:

207 to 208°C. 206 to 214°C.  
(at 760 mm.) (at 760 mm.)

Specific Gravity: 0.868 at 22°C.

Flash Point: 180°F. (open)

## ANETHOLE

## Synonyms:

anise camphor	p-propenyl-
isoestragole	anisole
4-methoxy-1-pro-	
penylbenzene	

## Formula:



## Characteristics:

sweet, burning	flavor of anise
taste	
strong odor	

Formula Weight: 148.2

Melting Point: 22.5° C.

Boiling Point: 234 to 237° C. (at 760 mm.)

## Specific Gravity:

0.991(20/20)	0.983 to 0.987
	(25/25)

## Refractive Index:

1.558 to 1.561 at 25° C.

## Uses:

manufacture of anisaldehyde, dentifrices, perfumes, soaps  
imbedding agent for microscopy  
sensitizer for photographic color  
bleeding  
fruit flavor

## Solubility (in grams per 100 ml.):

very slightly soluble in water	20.96 (in alcohol)
soluble in ether, chloroform, benzene, acetone, carbon disulfide, and ethyl acetate	

## ANILINE

## Synonyms:

aminobenzene	aniline oil
aminophen	phenylamine

Formula:  $\text{C}_6\text{H}_5\text{NH}_2$ 

## Characteristics:

highly refractive	burning taste
oily	characteristic
toxic	odor

Formula Weight: 93.1

Melting Point: -6.2° C.

## Boiling Point:

184.4° C.	183.5 to 185.0° C.
(at 760 mm.)	(at 760 mm.)

## Specific Gravity:

1.021(25/25)	1.027(15/15)
1.022(20/4)	
8.6 lbs. per gal. at 15° C.	

## Refractive Index:

1.5863	1.5821 at 25° C.
--------	------------------

## Surface Tension (dynes per cm.):

44.0 (air) at 10° C.	24.4 at 180° C.
42.9 at 20° C.	

## Viscosity (centipoises):

8.65 at 0° C.	3.19 at 30° C.
4.40 at 20° C.	2.41 at 40° C.
1.89 at 50° C.	

Flash Point: 168° F. (closed)

Heat of Vaporization (gram-calories per g.): 103.7 at 15° C.

Heat of Fusion (gram-calories per g.): 21.0 at 15° C.

Heat of Combustion (kilogram-calories per g.-mol.): 811.7 (liquid)

## Uses:

acetanilide	blue print paper
aniline dyes	paints and
	varnishes
intermediate for drugs and pharmaceuticals, synthetic aromatic chemicals, azo dyes	
germicides	toluidine
tannin	vulcanizing
tetranitro-aniline	accelerator

## Solubility (grams per 100 ml.):

3.6 (in water)	∞ (in ether)
at 18° C.	∞ (in chloroform)
6.4 (in water)	∞ (in carbon
at 90° C.	tetrachloride)
∞ (in alcohol)	∞ (in benzene)
	∞ (in acetone)

## ANILINE (Cont.)

## Additional Data:

critical temperature, 426° C.  
 critical pressure, 52.4 atm.  
 vapor density, 3.22  
 weight of vapor, 4150 mg./*l*.  
 autoignition temperature, 1418° F.  
 volatile with steam  
 darkens in air and light

## ANILINE ACETATE

Synonyms: phenylamine acetate

Formula:  $C_6H_5NH_2 \cdot CH_3COOH$

Formula Weight: 153.2

Specific Gravity: 1.07

Uses: organic synthesis

Solubility:

$\infty$  (in water)  $\infty$  (in alcohol)

Additional Data: darkens with age

## 2-ANILINOETHANOL

Synonyms:

$\beta$ -anilinoethanol phenylethanol-  
 ethoxyaniline amine  
 $\beta$ -hydroxyethyl-  
 aniline

Formula:  $C_6H_5NHCH_2CH_2OH$

Formula Weight: 137.2

Melting Point: 35 $\pm$ ° C.

Boiling Point:

286° C. 285.2° C.  
 (at 760 mm.) (at 760 mm.)

Specific Gravity:

1.097(20/20) 1.110(0/4)  
 9.1 lbs. per gal at 20° C.

Flash Point: 305° F. (open)

Uses: synthesis of dyes

Solubility (grams per 100 ml.):

4.6 at 20° C. soluble in ether  
 (in water) soluble in  
 15.4 (in alcohol) chloroform

## ANISALDEHYDE

Synonyms:

anisic aldehyde methyl p-oxyben-  
 aubepine zaldehyde  
 p-methoxybenza-  
 aldehyde

Formula:  $CH_3OC_6H_4CHO$

Characteristics:

strawberry flavor oily  
 aromatic odor of blossoming hawthorn  
 and coumarin  
 sharp, bitter, burning taste

Formula Weight: 136.1

Melting Point: 0 to 2.5° C.

Boiling Point: 246 to 248° C. (at 760 mm.)

Specific Gravity:

1.123(20/4) 1.119(15/4)

Refractive Index: 1.5764 at 12.7° C.

Uses:

new-mown hay and hawthorn type per-  
 fumes  
 formulation of apple, cherry, goose-  
 berry, grape, honey, hops, lemon,  
 melon, orange, pineapple, straw-  
 berry, and walnut flavors

Solubility (in grams per 100 ml.):

0.2 (in water)  $\infty$  (in ether)  
 $\infty$  (in alcohol)

Additional Data:

miscible with fatty oils

m-ANISIDINE

Synonyms:

3-aminoanisole m-methoxy-  
 1-amino-3-meth- aniline  
 oxybenzene

Formula:  $NH_2C_6H_4OCH_3$

Characteristics:

yellow toxic

Formula Weight: 123.2

Melting Point: < -12° C.

Boiling Point: 251° C. (at 760 mm.)

Specific Gravity: 1.096 at 20° C.  
Solubility:  
very slightly sol-      soluble in alcohol  
uble in water      soluble in ether

o-ANISIDINE

Synonyms:  
2-aminoanisole      o-methoxy-  
1-amino-2-meth-      aniline  
oxybenzene  
Formula:  $\text{NH}_2\text{C}_6\text{H}_4\text{OCH}_3$   
Characteristics: oily  
Formula Weight: 123.2  
Melting Point: 3 to 5.2° C.  
Boiling Point:  
251° C.      218 to 225° C.  
(at 760 mm.)      (at 760 mm.)  
223 to 226° C. (at 760 mm.)

Specific Gravity:  
1.096(20/4)      1.0923(20/4)  
1.098(15/15)      1.108 at 26° C.

Refractive Index: 1.5754

Uses:  
component of azo      dye inter-  
dyes      mediate  
Solubility:  
very slightly sol-      very soluble in  
uble in water      ether  
very soluble in      soluble in acids  
alcohol  
Additional Data:  
should be stored in tightly closed con-  
tainers and away from light  
avoid breathing and contact with skin  
becomes brown in air  
volatile with steam

ANISOLE

Synonyms:  
anisol      methyl phenyl  
anisole      ether  
methoxybenzene  
Formula:  $\text{CH}_3\text{OC}_6\text{H}_5$

Formula Weight: 108.1  
Melting Point: -37.3° C.  
Boiling Point:  
154 to 155      8° C. (at 10 mm.)  
(at 760 mm.)  
Specific Gravity:  
0.990(22/4)      0.9954(20/4)  
0.9988(15/15)  
Refractive Index:  
1.5179      1.5150 at 22° C.  
Surface Tension (dynes per cm.):  
36.4 (air) at 10° C. 35.2 at 20° C.  
28.0 at 80° C.

Viscosity (centipoises): 1.11 at 20° C.  
Heat of Combustion (kilogram-calories  
per g.): 905.1 (liquid)

Uses:  
insecticides      perfume  
intermediate

Solubility:  
insoluble in water      soluble in ether  
soluble in alcohol

ANISOYL CHLORIDE

Synonyms:  
p-methoxybenzoyl chloride  
Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{COCl}$   
Formula Weight: 170.6  
Melting Point: 22 to 23° C.

Boiling Point:  
263° C. (at 760 mm.) slight decom-  
position

Solubility:  
decomposes in      soluble in ether  
water  
slight decomposition  
in alcohol

ANTHRANIL

Synonyms: benzopseudodoxazole  
Formula:  $\text{ON:C}_6\text{H}_4\text{:CH}$   
Formula Weight: 119.1

## ANTHRANIL (Cont.)

Melting Point:  $< -18^{\circ}\text{C}$ .Boiling Point: decomposes at  $> 215^{\circ}\text{C}$ .

Specific Gravity: 1.187(15/4)

Refractive Index: 1.5861

## Solubility:

slightly soluble in hot water  
soluble in alcohol, ether, cold hydrochloric acid, and common organic solvents

## B

## BENZALDEHYDE

## Synonyms:

synthetic almond oil	benzoyl hydride
benzene carbonal	artificial oil of
benzoic aldehyde	bitter almonds

Formula:  $\text{C}_6\text{H}_5\text{CHO}$ 

## Characteristics:

oily  
characteristic almond odor  
aromatic  
bitter, burning taste  
almond flavor  
highly refractive

Formula Weight: 106.1

Melting Point:  $-26^{\circ}\text{C}$ .Solidification Point:  $-56^{\circ}\text{C}$ .

Boiling Point:  $177$  to  $179^{\circ}\text{C}$ . (at 760 mm.)  
 $112.5$  to  $113^{\circ}\text{C}$ . (at 100 mm.)

## Specific Gravity:

1.046(20/4)                      1.0504(15/4)  
1.043 at  $25^{\circ}\text{C}$ .

## Refractive Index:

1.5456; 1.5463 at  $19.6^{\circ}\text{C}$ .

Surface Tension (dynes per cm.): 40.04

## Flash Point:

$165^{\circ}\text{F}$ . (open)                       $148^{\circ}\text{F}$ . (closed)

Heat of Vaporization (gram-calories per g.):  $86.5$  at  $15^{\circ}\text{C}$ .

Heat of Combustion (kilogram-calories per g.-mol): **841.3** (liquid)

## Uses:

cinnamic acid	cellulose
dyes	derivatives
mandelic acid	perfumes
whisky and various fruit flavors	soaps

## Solubility (grams per 100 ml):

0.33 (in water)	$\infty$ (fixed oils)
$\infty$ (in alcohol)	$\infty$ (volatile oils)
$\infty$ (in ether)	

## Additional Data:

vapor density 3.66  
becomes yellow with age  
volatile in steam  
should be stored in tightly closed containers and away from light

## Solubility in Water-Alcohol Mixtures

Alcohol (%)	Ratio	Alcohol (%)	Ratio
25 . . . .	1:100	60 . . . . .	1:3
30 . . . .	1:30	70 . . . . .	2:3
50 . . . .	1:8		

## BENZEDRINE

## Synonyms:

amphetamine	<u>dℓ</u> - <u>d</u> -methyl-
<u>dℓ</u> - <u>d</u> -methyl-	phenethylamine
phenylethylamine	<u>dℓ</u> -2-phenyliso-
<u>dℓ</u> -desoxynorephe-	propylamine
drine	

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}(\text{NH}_2)\text{CH}_3$

**Characteristics:**

characteristic strong odor  
slightly burning taste

**Formula Weight:** 135.2

**Boiling Point:** 203 to 205°C. (at 760 mm.)  
with decomposition  
63 to 64°C. (at 7 mm.)

**Specific Gravity:** 0.931

**Uses:**

medical applications  
constricts blood vessels of mucous-  
membranes  
stimulant for nervous exhaustion

**Solubility:**

slightly soluble in water  
soluble in alcohol, ether, chloroform,  
acids, and ethyl acetate

**BENZENE****Synonyms:**

benzol	phene
benzole	phenyl hydride
cyclohexatriene	

**Formula:**  $C_6H_6$

**Characteristics:**

characteristic odor      highly refractive  
inflammable

**Formula Weight:** 78.1

**Melting Point:** 5.4 to 5.5°C

**Boiling Point:** 80.1°C. (at 760 mm.)

**Specific Gravity:**

0.8794(20/4)      0.8787(15/4)  
7.34 lbs. per gal.

**Refractive Index:**

1.5014      1.5016 at 29°C.

**Surface Tension (dynes per cm.):**

31.6 (air) at 20°C.	31.7 (vapor) at 0°C.
28.9 at 20°C.	29.0 at 20°C.
21.3 at 80°C.	18.8 at 100°C.

**Viscosity (centipoises):**

0.906 at 0°C.	0.567 at 30°C.
0.763 at 10°C.	0.498 at 40°C.
0.654 at 20°C.	0.444 at 50°C.
0.359 at 70°C.	

**Inflammability Range (volume per cent in air):** 1.4 (lower limit)  
6.9 to 8 (upper limit)

**Flash Point:** 10 to 12°F. (closed)

**Heat of Vaporization:**

94.4 (gram-calories per g.)  
170 (Btu. per lb.)

**Heat of Fusion:**

30.1 (gram-calories per g.) at 15°C.  
54.9 (Btu. per lb)

**Heat of Combustion (kilogram-calories per g.):** 782.3 (liquid)

**Uses:**

solvent for artificial leather, celluloid,  
fats, oils, resins, waxes

airplane dopes	medicine
antipyrin	nitrobenzene
blackings	oil cloth
coke ovens	organic
disinfectants	chemicals
dyes	paint removers
dye intermediates	perfumes
dry cleaning com-	phenacetin
pounds	phenol
engraving	photography
gasoline	picric acid
glue stock	rubber cements
degreasing	saccharin
indigo dyes	salicylic acid
lacquers	shoe polish soaps
linoleum	spreading com-
lithographing	pound
textile cleaning	splicing
and preservations	solutions

**Solubility (grams per 100 ml.):**

0.06 (of water)	∞ (in ether)
0.07 (in water)	∞ (in acetic acid)
at 22°C.	∞ (in acetone)
∞ (in absolute	∞ (in toluene)
alcohol)	

Soluble in chloroform, carbon disul-  
fide, carbon tetrachloride, and oils

**Additional Data:**

should be stored in tightly closed con-  
tainers and away from light

## BENZENE (cont.)

Liquid Density  
(760 mm., 60° F.)

0.881 g./ml.  
29.1 ° API  
7.336 lbs./gal.  
0.0113 g.-mol.  
9.399 lb.-mol./100 gal.

Gas Density  
(760 mm., 60° F.)

2.695 sp.gr. air = 1.00  
205.7 lb./1000 air ft.  
35.7 cu. ft. gas/gal. liquid  
267 unit vol. gas/unit vol. liquid  
34.6 cu. ft. vapor/gal. liquid

## BENZENESELENOL

Synonyms: selenophenol

Formula:  $C_6H_5SeH$

Characteristics: oily

Formula Weight: 157.1

Boiling Point:

183 to 186° C. (at 760 mm.)

Specific Gravity: 1.487 at 15° C.

Solubility:

very slightly soluble in water  
very soluble in ether  
very soluble in carbon tetrachloride

## BENZENETHIOL

Synonyms:

phenyl mercaptan      thiophenol  
thiopheneol

Formula:  $C_6H_5SH$

Formula Weight: 110.2

Boiling Point:

168 to 169° C. (at 760 mm.)

Specific Gravity: 1.074(23/4)

Solubility:

very slightly sol-      ∞ (in ether)  
uble in water      ∞ (in benzene)  
very soluble in      ∞ (in carbon  
alcohol      disulfide)

## 3(2)-BENZOFURAN

Synonyms:

benzfuran      coumarone  
benzofuranone

Formula:  $C_6H_4CH:CHO$

Formula Weight: 118.1

Melting Point: < -18° C.

Boiling Point:

173 to 174° C. (at 760 mm.)

Specific Gravity: 1.0776(15/15)

Refractive Index: 1.5645 at 22.7° C.

Solubility:

insoluble in water  
soluble in alcohol, ether, alkali

## BENZONITRILE

Synonyms:

benzenecarbonitrile      benzoic nitrile  
cyanobenzene      phenyl cyanide

Formula:  $C_6H_5CN$

Characteristics:

oily      burning taste  
odor like essential oil of almonds

Formula Weight: 103.1

Melting Point: -12.9° C.

Boiling Point:

190 to 192° C. (at 760 mm.)

Specific Gravity:

1.001(25/4)      1.0102(15/15)

Refractive Index: 1.5289

Surface Tension (dynes per cm.):

40.2 at 0° C.      39.1 at 20° C.  
29.9 at 100° C.

Heat of Combustion (kilogram-calories  
per g.-mol): 865.5 (liquid)

Solubility (grams per 100 ml.):

1 at 100° C. (in water)  
∞ (in alcohol)      ∞ (in ether)

Additional Data:

inflammable      highly toxic

## BENZOYL BROMIDE

Synonyms: benzenecarbonyl bromide

Formula:  $C_6H_5COBr$

Characteristics: fumes

Formula Weight: 185.0

Melting Point:  $0 \pm ^\circ C$ .

Boiling Point:

218 to  $219^\circ C$ . (at 760 mm.)

Specific Gravity: 1.570(20/4)

Solubility:

decomposes in water

slight decomposition in alcohol

$\infty$  (in ether)

Additional Data: freezes at  $-24^\circ C$ .

## BENZOYL CHLORIDE

Synonyms: benzenecarbonyl chloride

Formula:  $C_6H_5COCl$

Characteristics:

fumes

penetrating odor

highly refractive

mobile

pungent

Formula Weight: 140.6

Melting Point:  $-0.5^\circ C$ .

Boiling Point:

$197.2^\circ C$ . (at 760 mm.)

$194^\circ C$ . (at 742 mm.)

Specific Gravity:

1.212(20/4)

1.2187(15/15)

1.211 to 1.213(20/20)

10 lbs. per gal. at  $20^\circ C$ .

Refractive Index:

1.5537

1.5503 at  $25^\circ C$ .

Flash Point:  $215^\circ F$ . (closed)

Heat of Combustion (kilogram-calories  
per g.-mol): 782.8 (liquid)

Uses:

dye intermediate

perfumes

organic synthesis

lachrymator

chemical test for alcohols and many

other organic compounds

Solubility:

decomposes in water

decomposed in hot alcohol

$\infty$  (in ether)

$\infty$  (in carbon tetrachloride)

soluble in benzene, carbon disulfide,  
oils

miscible with most organic solvents

Additional Data:

fumes cause tears

fire point  $185^\circ F$ .

vapor density 4.88

should be stored in tightly closed  
containers.

## BENZOYL FLUORIDE

Synonyms: benzenecarbonyl fluoride

Formula:  $C_6H_5COF$

Characteristics: fumes

Formula Weight: 124.1

Boiling Point:  $161.5^\circ C$ . (at 45 mm.)

Specific Gravity:  $>1$ .

Solubility:

decomposes in hot water

very soluble in alcohol, decomposes  
when the solvent is hot

soluble in ether

## BENZYL ACETATE

Synonyms:

acetic acid benzyl ester

benzyl ethanoate

Formula:  $CH_3COOCH_2C_6H_5$

Characteristics:

pleasant, pear-like odor and flavor  
bitter, burning taste

Formula Weight: 150.2

Melting Point:  $-51.5^\circ C$ .

Boiling Point: 213 to  $215^\circ C$ . (at 760 mm.)

Specific Gravity: 1.057 at  $17^\circ C$ .

Refractive Index: 1.5232

Flash Point:  $216^\circ F$ . (closed)

## BENZYL ACETATE (Cont.)

## Uses:

artificial, flowery perfumes  
soaps  
solvent for cellulose acetate and  
nitrate, many resins, dopes,  
lacquers, oils, polishes, printing  
inks, varnish removers

Solubility: insoluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## Additional Data:

auto-ignition temperature, 862° F.  
vapor density, 5.17

## Solubility in Water-Alcohol Mixtures

(%)	(Ratio)
30 . . . . .	1:200
35 . . . . .	1:120
40 . . . . .	1:70
50 . . . . .	1:20
60 . . . . .	1:5
70 . . . . .	1:1

## BENZYL ACRYLATE

Synonyms: acrylic acid benzyl ester

Formula:  $\text{CH}_3\text{COOCH}_2\text{C}_6\text{H}_5$

Formula Weight: 162.2

Boiling Point: 113 to 114° C. (at 19 mm.)

Specific Gravity: 1.068(20/4)

Refractive Index: 1.513 at 24° C.

Solubility: insoluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## BENZYL ALCOHOL

## Synonyms:

$\alpha$ -hydroxytoluene phenmethylol  
phenylcarbinol phenyl methyl  
alcohol

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$

## Characteristics:

slight aromatic odor  
sharp, burning taste  
clear colorless to bright yellow

Formula Weight: 108.1

Melting Point: -15.3° C.

## Boiling Point:

204.7° C. (at 760 mm.)  
199 to 204° C. (at 760 mm.)  
93° C. (at 10 mm.)  
204 to 208° C. (at 760 mm.)

## Specific Gravity:

1.043(20/4) 1.050(15/15)  
8.71 lbs. per gal. at 20° C.

Refractive Index: 1.5396

## Flash Point:

220° F. (open) 213° F. (closed)

Heat of Combustion (kilogram-calories  
per g.-mol): 894.3 (liquid)

## Uses:

local anesthetic imbedding agent  
pharmaceuticals in microscopy  
flavors organic  
dyes synthesis  
perfumes  
solvent for cellulose acetate, lacquer  
resins, gums, waxes

## Solubility (grams per 100 ml.):

8.37 (of water)  $\infty$  (in ether)  
at 20° C.  $\infty$  (in chloroform)  
4 (in water) at 17° C.  $\infty$  (in methyl  
 $\infty$  (in alcohol) alcohol)  
soluble in acetone

## Additional Data:

auto-ignition temperature, 817° F.  
vapor density, 3.72  
coefficient of expansion 0.00073 at 10  
to 30° C.  
fire point, 205° F.

## BENZYLAMINE

## Synonyms:

$\omega$ -aminotoluene  $\alpha$ -aminotoluen

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$

Formula Weight: 107.2

Boiling Point: 184.5° C. (at 760 mm.)

Specific Gravity: 0.982(20/24)

Refractive Index: 1.5401

Surface Tension (dynes per cm.):  
 39.5 at 20°C.                      36.5 at 45°C.  
    33.1 at 75°C.

Viscosity (centipoises): 1.59 at 25°C.

Heat of Combustion (kilogram-calories  
 per g.-mol): 969.4 (liquid)

Uses: organic synthesis

Solubility:  
 ∞ (in water)                      ∞ (in ether)  
    ∞ (in alcohol)

Additional Data: strongly alkaline

### BENZYL BENZOATE

Synonyms: Benzoic acid benzyl ester

Formula:  $C_6H_5COOCH_2C_6H_5$

Characteristics:  
 slight aromatic odor      oily  
 bitter-sweet, sharp, burning taste

Formula Weight: 212.1

Melting Point: 21°C.

Boiling Point: 323 to 324°C. (at 760 mm.)

Specific Gravity: 1.114 at 18°C.

Refractive Index: 1.504; 1.5681 at 21°C.

Flash Point: 298°F. (closed)

Uses:  
 solvent for cellulose acetate, nitro-  
 cellulose, synthetic musk  
 perfume fixative  
 confectionery flavor

Solubility: insoluble in water  
 ∞ (in alcohol)                      ∞ (in carbon  
 ∞ (in ether)                      tetrachloride)  
 ∞ (in glycerine)                      ∞ (in oils)

Additional Data: vapor density 7.31

Solubility in Water-Alcohol Mixtures

(%)	(Ratio)
45 . . . . .	1:1000
70 . . . . .	3:100
90 . . . . .	1:2
95 . . . . .	1:1

### BENZYL BUTYL ETHER

Synonyms:  
 1-benzyloxybutane      butyl benzyl ether

Formula:  $CH_3(CH_2)_3OCH_2C_6H_5$

Formula Weight: 164.1

Boiling Point:  
 216 to 220°C. (at 760 mm.)  
 220 to 221°C. (at 744 mm.)

Specific Gravity: 0.9310(10/4)

Solubility: insoluble in water  
 ∞ (in alcohol)                      ∞ (in ether)

### BENZYL BUTYRATE

Formula:  $C_2H_5CH_2COOCH_2C_6H_5$

Characteristics: weak, jasmine-like odor  
 sweet taste                      pear flavor

Formula Weight: 178.2

Boiling Point: 238 to 240°C. (at 760 mm.)

Specific Gravity: 1.016(16/18)

Uses: plasticizer                      fruit flavors

Solubility: insoluble in water  
 very soluble in alcohol  
 very soluble in ether

### BENZYL "CARBITOL"

Synonyms:  
 diethylene glycol monobenzyl ether

Formula:  
 $HOCH_2CH_2OCH_2CH_2OCH_2C_6H_5$

Formula Weight: 196.2

Boiling Point: 176 to 179°C. (at 18 mm.)

### BENZYL "CELLOSOLVE"

Synonyms:  
 ethylene glycol monobenzyl ether

Formula:  $C_6H_5CH_2OCH_2CH_2OH$

Formula Weight: 152.2

Melting Point: <-25°C.

## BENZYL "CELLOSOLVE" (Cont.)

Boiling Point: 256° C. (at 760 mm.)  
248 to 260° C. (at 760 mm.)

Vapor Pressure:  
 0.02 at 20° C.      <1 at 30° C.

Specific Gravity: 1.0700(20/20)  
8.9 lbs. per gal. at 20° C.

Flash Point: 265° F. (open)

Solubility (grams per 100 ml.):  
18 at 20° C. (of water)  
0.4 (in water)

Additional Data:  
 coefficient of expansion, 0.00076 at 10  
 to 30° C.

## BENZYL CHLOROACETATE

Synonyms:  
 chloroacetic acid benzyl ester

Formula:  $\text{CH}_3\text{ClCOOCH}_2\text{C}_6\text{H}_5$

Characteristics: oily

Formula Weight: 184.6

Boiling Point: 147.5° C. (at 9 mm.)

Specific Gravity: 1.222(4/4)

## BENZYLDIETHYLAMINE

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{N}(\text{C}_2\text{H}_5)_2$

Characteristics: almond odor

Formula Weight: 163.3

Melting Point: <-50° C.

Boiling Point: 207 to 215° C. (at 760 mm.)

Specific Gravity: 0.89(20/20)

Refractive Index: 1.497

Viscosity (centipoises): 1.55 at 25° C.

Flash Point: 170° F. (closed)

Additional Data:  
 coefficient of expansion, 0.00097 per ° C.

## BENZYL DIMETHYL METHANOL

Synonyms:

$\alpha$ -benzyl isopropyl alcohol      dimethyl benzyl carbinol

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{C}(\text{CH}_3)_2\text{OH}$

Characteristics: jasmine-like odor  
 bitter taste      pear flavor

Formula Weight: 150.2

Melting Point: 21 to 24° C.

Boiling Point: 228° C. (at 760 mm.)  
 214 to 217° C. (at 760 mm.)

Specific Gravity: 0.979(16/4)

Uses: apple, pear and quince fruit  
 essences

Solubility:  
 insoluble in water  
 insoluble in 30% alcohol  
 one part is soluble in 2 parts 60%  
 alcohol and 5 parts 50% alcohol

## BENZYL ETHER

Synonyms: dibenzyl ether

Formula:  $(\text{C}_6\text{H}_5\text{CH}_2)_2\text{O}$

Characteristics: oily; slight almond odor

Formula weight: 198.3

Melting Point: 4 to 5° C.

Boiling Point: 295 to 298° C. (at 760 mm.)  
 157 to 160° C. (at 15 mm.)

Specific Gravity:  
 1.048(20/4)      1.036 at 16° C.

Flash Point: 275° F. (closed)

Solubility: insoluble in water  
 soluble in hot alcohol      soluble in ether

Additional Data: vapor density, 6.82

## BENZYLETHYLANILINE

Synonyms: ethylbenzylaniline

Formula:  
 $\text{C}_6\text{H}_5\text{N}(\text{C}_2\text{H}_5)\text{CH}_2\text{C}_6\text{H}_5$

Characteristics: pale yellow; oily

Formula Weight: 211.3

Boiling Point: 285 to 287°C. (at 710 mm.)  
slight decomposition

Specific Gravity: 1.034(18.5/4)

Uses: dyes; organic synthesis

Solubility (grams per 100 ml.):

insoluble in water ∞ (in ether)  
18 (in alcohol) ∞ (in chloroform)  
soluble in common organic solvents

### BENZYL ETHYL ETHER

Synonyms:

*α*-ethoxytoluene ethyl benzyl ether

Formula:  $C_2H_5OCH_2C_6H_5$

Formula Weight: 136.2

Boiling Point: 185°C. (at 760 mm.)  
187 to 189°C. (at 732 mm.)

Specific Gravity: 0.949(20/4)

Solubility: insoluble in water  
∞ (in alcohol) ∞ (in ether)

### BENZYL FORMATE

Synonyms:

benzyl methanoate formic acid  
benzyl ester

Formula:  $HCOOCH_2C_6H_5$

Characteristics:

sweet, aromatic odor  
very sweet taste, similar to apricot-  
pineapple flavor

Formula Weight: 136.1

Melting Point: 3.6°C.

Boiling Point:

203.4°C. (at 760 mm.)  
202 to 203°C. (at 747 mm.)  
84°C. (at 10 mm.)

Specific Gravity: 1.081(20/4)

Uses: various fruit essences

Solubility: insoluble in water

soluble in alcohol ∞ (in ether)

one part is soluble in 30 parts of 45%  
alcohol and 1 part of 90% alcohol

### BENZYL ISOAMYL ETHER

Formula:  $C_6H_5CH_2OC_5H_{11}$

Formula Weight: 178.3

Boiling Point: 237°C. (at 748 mm.)

Solubility: insoluble in water  
soluble in alcohol soluble in ether

### BENZYL ISOTHIOCYANATE

Synonyms: benzyl mustard oil  
isothiocyanic acid benzyl ester

Formula:  $C_6H_5CH_2NCS$

Formula Weight: 149.2

Boiling Point: 243°C. (at 760 mm.)

Specific Gravity: 1.125(15/4)

Solubility:  
insoluble in water soluble in ether

### BENZYL LACTATE

Synonyms: lactic acid benzyl ester

Formula:  $CH_2CHOHCOOCH_2C_6H_5$

Formula Weight: 180.2

Boiling Point: 136 to 138°C. (at 10 mm.)

### BENZYL MALEATE

Synonyms: dibenzyl maleate  
maleic acid benzyl ester

Formula:

$C_6H_5CH_2OOCCH:CHCOOCH_2C_6H_5$

Characteristics: oily

Formula Weight: 296.3

Boiling Point: 241°C. (at 14 mm.)

## BENZYL METHYL ETHER

Synonyms: methyl benzyl ether

Formula:  $\text{CH}_3\text{OCH}_2\text{C}_6\text{H}_5$

Formula Weight: 122.2

Boiling Point:  $174^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.97(15/15)

Solubility: insoluble in water  
soluble in alcohol      soluble in ether

## BENZYLOXYAMINE

Synonyms:  $\alpha$ -benzylhydroxylamine  
phenylmethoxyamine

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{ONH}_2$

Characteristics: oily

Formula Weight: 123.2

Boiling Point:  $118$  to  $119^\circ\text{C}$ . (at 30 mm.)

## BENZYLPHENYLHYDRAZINE

Formula:  $(\text{C}_7\text{H}_7)(\text{C}_6\text{H}_5)\text{NNH}_2$

Characteristics: oily

Formula Weight: 198.3

Boiling Point:  $216$  to  $218^\circ\text{C}$ . (at 38 mm.)

## BENZYL PROPIONATE

Synonyms: propionic acid benzyl ester

Formula:  $\text{C}_2\text{H}_5\text{COOCH}_2\text{C}_6\text{H}_5$

Characteristics:

fruity, jasmine-rose odor  
very sweet taste  
apricot-peach flavor

Formula Weight: 164.2

Boiling Point:  $219$  to  $222^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.036(16.5/17.5)

Uses: synthetic raspberry and cherry  
flavors

Solubility: insoluble in water  
one part is soluble in 11 parts of 60%  
alcohol and 4 parts of 70% alcohol

## BENZYL SALICYLATE

Synonyms: salicylic acid benzyl ester

Formula:  $\text{HOC}_6\text{H}_4\text{COOCH}_2\text{C}_6\text{H}_5$

Characteristics:

oily	faint, pleasant
raspberry flavor	odor of
sweet taste	elderberry

Formula Weight: 228.2

Boiling Point:  $208^\circ\text{C}$ . (at 26 mm.)  
 $186$  to  $188^\circ\text{C}$ . (at 10 mm.)

Specific Gravity: 1.176(19.5/15)

Uses: perfume fixative

apple, apricot, banana, cherry, goose-  
berry, plum, raspberry, strawberry,  
and woodruff flavors

Solubility (in grams per 100 ml.):  
very slightly soluble in water  
 $10$  (in alcohol)       $\infty$  (in ether)

m-BENZYL TOLUENE

Synonyms: phenyl-m-tolylmethane

Formula:  $\text{C}_6\text{H}_5\text{CHC}_6\text{H}_4\text{CH}_3$

Formula Weight: 182.3

Boiling Point:  $275^\circ\text{C}$ . (at 747 mm.)

Specific Gravity: 0.997 at  $17.5^\circ\text{C}$ .

Solubility:

soluble in alcohol      soluble in ether

p-BENZYL TOLUENE

Synonyms: phenyl-p-tolylmethane

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{C}_6\text{H}_4\text{CH}_3$

Formula Weight: 182.3

Melting Point:  $-30^\circ\text{C}$ .

Boiling Point:  $285$  to  $286^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.994 at  $18^\circ\text{C}$ .

Solubility: very soluble in alcohol, ether  
chloroform

## BIACETYL

## Synonyms:

2,3-butanedione      diketobutane  
diacetyl              dimethyldiketone

Formula:  $\text{CH}_3\text{COCOCH}_3$

## Characteristics:

yellow-green              quinone odor  
very dilute solution smells like butter

Formula Weight: 86.1

Melting Point:  $-4$  to  $-3^\circ\text{C}$ .

Boiling Point:  $87$  to  $88^\circ\text{C}$ . (at  $760$  mm.)

## Specific Gravity:

$0.981(18.5/4)$                $0.9904(15/15)$

Refractive Index:  $1.3933$  at  $18^\circ\text{C}$ .

Uses: aroma carrier for butter, coffee,  
honey, vinegar

Solubility (grams per  $100$  ml.):

$25$  at  $15^\circ\text{C}$ .               $\infty$  (in alcohol)  
(in water)               $\infty$  (in ether)

## BIALLYL

Synonyms: diallyl, 1,5-hexadiene

Formula:  $\text{CH}_2:\text{CHCH}_2\text{CH}_2\text{CH}:\text{CH}_2$

Formula Weight: 82.1

Melting Point:  $-141^\circ\text{C}$ .

Boiling Point:  $59.6^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.6880(20/4)$

Refractive Index:  $1.4044$

Solubility: insoluble in water

## BICYCLOHEXYL

Synonyms: decahydrobiphenyl

decahydrodiphenyl      dicyclohexyl

Formula:  $(\text{CH}_2(\text{CH}_2)_4\text{CH})_2$

Characteristics: mobile liquid  
characteristic aromatic odor

Formula Weight: 166.3

Melting Point:  $3.7^\circ\text{C}$ ;  $2.2^\circ\text{C}$ .

## Boiling Point:

$234^\circ\text{C}$ . (at  $760$  mm.)

$236^\circ\text{C}$ . (at  $758$  mm.)

$238$  to  $240^\circ\text{C}$ . (at  $760$  mm.)

## Specific Gravity:

$0.886(21/4)$                $0.8644$  at  $20^\circ\text{C}$ .

$0.885(25/25)$                $0.884(25/15.6)$

$7.4$  lbs. per gal. at  $25^\circ\text{C}$ .

## Refractive Index:

$1.4766$                $1.4790$  at  $25^\circ\text{C}$ .

## Viscosity (centipoises):

$3.5$  at  $25^\circ\text{C}$ .               $1.7$  at  $60^\circ\text{C}$ .

$34.2$  S.U.S. at  $100^\circ\text{F}$ .

Flash Point:  $215^\circ\text{F}$ . (closed)

## Uses:

high boiling              dielectric  
solvent                  plasticizer

Solubility (grams per  $100$  ml.):

$0.1$  (in water)               $\infty$  (in carbon  
 $\infty$  (in alcohol)              tetrachloride)  
 $\infty$  (in ether)               $\infty$  (in benzene)  
 $\infty$  (in acetone)  
 $7$  at  $25^\circ\text{C}$ . (in methyl alcohol)  
soluble in most organic solvents

## Additional Data:

fire point,  $220^\circ\text{F}$ .

power factor,  $1000$  cycles  $0.006\%$

specific resistivity,  $1.9 \times 10^4$  ohm cm.

dielectric strength  $31,500$  volts at  
 $0.1''$  gap

dielectric constant,  $1000$  cycles  $2.1$

BIS[2-(2-CHLOROETHOXY)]  
ETHYL ETHER

Synonyms: tetraglycol dichloride

## Formula:

$(\text{CH}_2\text{ClCH}_2\text{OCH}_2\text{CH}_2)_2\text{O}$

Formula Weight: 231.1

Boiling Point:  $114^\circ\text{C}$ . (at  $2$  mm.)

Specific Gravity:  $1.186(20/20)$

Flash Point:  $>250^\circ\text{F}$ . (closed)

# BIS[2-(2-CHLOROETHOXY)] ETHYL ETHER (Cont.)

## Uses:

high boiling solvent  
organic synthesis of dyes, pharma-  
ceuticals, resins  
extractant for fats, greases, oils,  
waxes

Solubility: slightly soluble in water

## BIS(2-CHLOROETHYL) CARBONATE

### Synonyms:

$\beta,\beta'$ -dichlorodiethyl carbonate

Formula:  $(\text{CH}_2\text{ClCH}_2\text{O})_2\text{CO}$

Characteristics: pale yellow

Formula Weight: 187.0

Boiling Point: 109 to 112°C. (at 12 mm.)

## BIS(2-CHLOROETHYL) ETHER

### Synonyms:

bis- $\beta$ -chloroethyl ether  
 $\beta,\beta'$ -dichloroethyl ether  
1-chloro-2-( $\beta$ -chloroethoxy)ethane

Formula:  $(\text{CH}_2\text{ClCH}_2)_2\text{O}$

Formula Weight: 143.0

Melting Point: -50°C.

Boiling Point: 178.5°C. (at 760 mm.)  
170 to 180°C. (at 760 mm.)

### Specific Gravity:

1.222(20/20) 1.222(20/4)  
10.2 lbs. per gal. at 20°C.

Refractive Index: 1.457; 1.454

Surface Tension (dynes per cm.):  
41.8 at 25°C.

Viscosity (centipoises): 2.0653 at 25°C.

### Flash Point:

185°F. (open) 131°F. (closed)

Specific Heat (gram-calories per gram  
per °C.): 0.36 at 20 to 30°C. (liquid)

Heat of Vaporization (gram-calories  
per g.): 64.1 at 178°C.

## Uses:

solvent for ethylcellulose, fats, gums,  
insoluble soaps, oils, pectins, resins,  
waxes  
dry cleaning organic soaps

### Solubility (grams per 100 ml.):

0.28 (of water) soluble in alcohol  
1.07 at 20°C. soluble in ether  
(in water)

miscible with most organic solvents  
except acetone, benzene, carbon tetra-  
chloride, methyl alcohol, V.M.P.  
naphtha  
immiscible with paraffin hydro-  
carbons

### Additional Data:

fire point, 195°F.  
apparent ignition temperature, 745°F.  
coefficient of expansion, 0.00097 at 10  
to 30°C.  
autoignition temperature, 696°F.  
vapor density, 4.93

## BIS(2-CHLOROETHYL) FORMAL

### Synonyms:

di-(2-chloroethyl) formal  
2,2'-dichloroethyl formal

Formula:  $\text{CH}_2(\text{OCH}_2\text{CH}_2\text{Cl})_2$

Formula Weight: 173.0

Boiling Point: 218.1°C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.1 at 20°C.

Specific Gravity: 1.2339(20/20)  
10.3 lbs. per gal. at 20°C.

Flash Point: 230°F. (open)

### Uses:

solvent for fats, greases, organic  
liquids, waxes  
manufacture of neoprene

### Solubility (grams per 100 ml.):

0.44 (of water) 0.78 (in water)  
decomposes in aqueous acidic solution

## BIS(2-CHLOROETHYL) SULFIDE

## Synonyms:

1-chloro-2-( $\beta$ -chloroethylthio)ethane  
2,2' or  $\beta, \beta'$ -dichlorodiethyl sulfide  
mustard gas

Formula:  $(\text{CH}_2\text{ClCH}_2)_2\text{S}$ 

Characteristics: oily pungent odor

Formula Weight: 159.1

Melting Point: 8 to  $14^\circ\text{C}.$ ;  $14.4^\circ\text{C}.$ 

## Boiling Point:

215 to  $217^\circ\text{C}.$  (at 760 mm.) with slight  
decomposition  
 $98^\circ\text{C}.$  (at 10 mm.)

Vapor Pressure (mm. Hg): 0.115 at  $20^\circ\text{C}.$ 

## Specific Gravity:

1.199(14/4) 1.2741 at  $20^\circ\text{C}.$ Refractive Index: 1.5313Heat of Fusion (gram-calories per g.):  
25Uses: organic synthesis  
military poison gas

## Solubility:

water is soluble in this material  
very slightly soluble with decomposition  
in water  
soluble in alcohol, ether, oils, benzene,  
carbon disulfide, chlorinated hydro-  
carbons, fats, kerosene, and other  
common organic solvents

## Additional Data:

vapor density, 5.4  
specific volume, 0.785 at  $20^\circ\text{C}.$   
volatility, 0.625 mg. per  $\ell$   
coefficient of expansion, 0.000881  
evaporates slowly  
very irritating and poisonous  
penetrates leather, rubber, and  
textile fibres

BIS( $\beta$ -CHLOROISOPROPYL) ETHER

## Synonyms:

$\beta, \beta$ -dichlorodiisopropyl ether  
dichloroisopropyl ether

## Formula:

 $\text{CH}_2\text{Cl}(\text{CH}_3)\text{CHOCH}(\text{CH}_3)\text{CH}_2\text{Cl}$ 

Formula Weight: 171.1

Melting Point:  $<-20^\circ\text{C}.$ Boiling Point:  $187.3^\circ\text{C}.$  (at 760 mm.)  
 $180$  to  $190^\circ\text{C}.$  (at 760 mm.)Vapor Pressure (mm. Hg): 0.85 at  $20^\circ\text{C}.$ 

## Specific Gravity:

1.1122(20/20) 1.1135(20/20)  
1.110 to 1.112(25/25)  
9.3 lbs. per gal. at  $20^\circ\text{C}.$

Refractive Index: 1.446Flash Point:  $185^\circ\text{F}.$  (closed)

## Uses:

solvent for fats, greases, waxes  
cleaning and spotting agents

## Solubility (grams per 100 ml.):

<u>0.14</u> (of water)	$\infty$ (in benzene)
<u>0.17</u> (in water)	$\infty$ (in carbon
$\infty$ (in methyl	tetrachloride)
alcohol)	$\infty$ (in ether)
$\infty$ (in acetone)	$\infty$ (in V.M.P.
	naphtha)

miscible with most oils and organic  
solvents

Additional Data: fire point,  $185^\circ\text{F}.$ 

## BIS(CHLOROMETHYL) ETHER

## Synonyms:

chloro(chloromethoxy)methane  
sym-dichlorodimethyl ether  
dichloromethyl oxide  
sym-dichloromethyl ether

Formula:  $(\text{CH}_2\text{Cl})_2\text{O}$ 

Characteristics: volatile

Formula Weight: 115.0

Boiling Point:  $104$  to  $105^\circ\text{C}.$  (at 760 mm.)

## Specific Gravity

1.328(15/4) 1.315(20/4)

Refractive Index: 1.4346

Uses: organic synthesis

## BIS(CHLOROMETHYL) ETHER (Cont.)

Solubility: decomposes in water

$\infty$ (in alcohol)	$\infty$ (in ether)
soluble in methyl alcohol	soluble in benzene

## BIS(X-CHLOROPHENYL) ETHER

Synonyms:

 $\alpha$ -dichlorodiphenyl etherFormula:  $C_{12}H_8OCl_2$ 

Characteristics:

mild odor	highly refractive
colorless to pale straw color	

Formula Weight: 239.1

Melting Point:  $-20^{\circ}C$ .Boiling Point:  $160$  to  $180^{\circ}C$ . (at 760 mm.)Specific Gravity:  $1.30$  to  $1.32(25/25)$ 

Viscosity (centipoises):

$10.0$ at $25^{\circ}C$ .	$3.6$ at $60^{\circ}C$ .
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Solubility:

insoluble in water	$\infty$ (in ether)
very soluble in methyl alcohol	
soluble in carbon tetrachloride	
$\infty$ (in acetone)	$\infty$ (in benzene)

## BIS(CHLOROPROPYL) CARBONATE

Synonyms:

 $\gamma, \gamma'$ -dichloropropyl carbonateFormula:  $[Cl(CH_2)_3O]_2CO$ 

Formula Weight: 215.1

Boiling Point:  $265$  to  $270^{\circ}C$ . (at 760 mm.)

## BIS(3-CHLOROPROPYL) ETHER

Synonyms:

 $\gamma, \gamma'$ -dichlorodipropyl etherFormula:  $(CH_2ClCH_2CH_2)_2O$ 

Characteristics: oily

Formula Weight: 171.1

Boiling Point:  $215^{\circ}C$ . (at 745 mm.)Specific Gravity:  $1.140(20/20)$ 

Solubility: very soluble in alcohol, ether, benzene

m, m'-BITOLYL

Synonyms:

3,3'-dimethylbiphenyl

m, m'-ditolylFormula:  $CH_3C_6H_4C_6H_4CH_3$ 

Characteristics: oily

Formula Weight: 182.3

Melting Point:  $5$  to  $7^{\circ}C$ .Boiling Point:  $286$  to  $287^{\circ}C$ . (at 713 mm.)Specific Gravity:  $0.9993(16/4)$ 

Solubility:

insoluble in water	soluble in ether
soluble in alcohol	soluble in benzene

o, m-BITOLYL

Synonyms:

2,3'-dimethylbiphenyl

o, m-ditolylFormula:  $CH_3C_6H_4C_6H_4CH_3$ 

Formula Weight: 182.3

Boiling Point:  $270$  to  $287.5^{\circ}C$ . (at 760 mm.)

Solubility: insoluble in water

soluble in alcohol, ether, benzene

o, o'-BITOLYL

Synonyms:

2,2'-dimethylbiphenyl

o, o'-ditolylFormula:  $CH_3C_6H_4C_6H_4CH_3$ 

Formula Weight: 182.3

Melting Point:  $17.8^{\circ}C$ .

Boiling Point:

 $272^{\circ}C$ . (at 760 mm.) $258^{\circ}C$ . (at 738 mm.)Specific Gravity:  $0.955(10/4)$ Solubility: very soluble in alcohol  
very soluble in ether

o,p'-BITOLYL

## Synonyms:

2,4'-dimethylbiphenyl

o,p'-ditolylFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{C}_6\text{H}_4\text{CH}_3$ 

Formula Weight: 182.3

Boiling Point: 272 to 280°C. (at 760 mm.)

## BROMAL

## Synonyms:

tribromoacetaldehyde

tribromoaldehyde

2,2,2-tribromoethanal

Formula:  $\text{CBr}_3\text{CHO}$ 

Characteristics: yellow

Formula Weight: 280.8

Boiling Point:

174°C. (at 760 mm.) with decomposition

Specific Gravity:

2.665(25/4); 2.30 at 15°C.

Solubility:

forms a hydrate with water

soluble in alcohol

soluble in ether

## BROMOACETONITRILE

Synonyms: bromomethyl cyanide

Formula:  $\text{CH}_2\text{BrCN}$ 

Characteristics: yellow; oily

Formula Weight: 120.0

Boiling Point: 148 to 150°C. (at 760 mm.)

Specific Gravity: 1.771

Solubility: soluble in ether

## BROMOACETYL BROMIDE

Synonyms: bromoethanoyl bromide

Formula:  $\text{CH}_2\text{BrCOBr}$ 

Formula Weight: 201.9

Boiling Point: 149 to 150°C. (at 760 mm.)

Specific Gravity: 2.317(21.5/21.5)

Solubility: decomposes in water  
decomposes in alcoholo-BROMOANISOLE

## Synonyms:

1-bromo-2-methoxybenzene

o-bromophenyl methyl etherFormula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{Br}$ 

Characteristics: oily

Formula Weight: 187.0

Boiling Point: 218 to 223°C. (at 760 mm.)

Specific Gravity: 1.5018(20/4)

Refractive Index: 1.5725

Solubility: insoluble in water

soluble in alcohol

soluble in ether

## BROMOBENZENE

## Synonyms:

bromobenzol

phenyl bromide

monobromobenzene

Formula:  $\text{C}_6\text{H}_5\text{Br}$ 

Characteristics:

oily

refractive

heavy mobile liquid

pleasant, characteristic odor

Formula Weight: 157.0

Melting Point: -30.6°C.

Boiling Point: 155 to 156.2°C. (at 760 mm.)

Specific Gravity

1.495(20/4)

1.4991(15/15)

12.5 lbs. per gal. at 20°C.

Refractive Index: 1.5598

1.5625 at 15°C.

1.5577 at 25°C.

Surface Tension (dynes per cm.):

37.7 at 10°C.

36.5 at 20°C.

27.2 at 100°C.

Flash Point: 149°F. (closed)

Specific Heat (gram-calories per g.

per °C.): 0.25 from 20 to 100°C.

## BROMOBENZENE (Cont.)

Uses: solvent for crystallizing, motor fuels, organic synthesis, tap cylinder compounds

## Solubility:

insoluble in water  $\infty$  (in chloroform)  
 very soluble in soluble in benzene  
 alcohol, ether  
 soluble in carbon tetrachloride  
 miscible with most organic liquids

## Additional Data:

fire point,  $311^{\circ}\text{F.}$  critical temper-  
 critical pressure, ature,  $397^{\circ}\text{C.}$   
 44.6 atm. vapor density,  
5.41

m-BROMOBENZOYL BROMIDE

Formula:  $\text{BrC}_6\text{H}_4\text{COBr}$

Formula Weight: 263.9

Boiling Point:  $118$  to  $122^{\circ}\text{C.}$  (at 20 mm.)

## 2-BROMOBIPHENYL

Synonyms: o-bromobiphenyl,  
2-bromodiphenyl

Formula:  $\text{C}_6\text{H}_5\text{C}_6\text{H}_4\text{Br}$

Formula Weight: 233.1

Melting Point:  $<-20^{\circ}\text{C.}$

Boiling Point:  $296$  to  $298^{\circ}\text{C.}$  (at 760 mm.)

## Solubility:

insoluble in water soluble in alcohol  
 very soluble in ether

## 2-BROMO-1,3-BUTADIENE

Synonyms: bromoprene

Formula:  $\text{CH}_2\text{:CBrCH:CH}_2$

Formula Weight: 133.0

Boiling Point:  $42$  to  $43^{\circ}\text{C.}$  (at 165 mm.)

Specific Gravity: 1.397

Refractive Index: 1.4988

Solubility: insoluble in water  
 soluble in alcohol soluble in ether

## 1-BROMOBUTANE

Synonyms: butyl bromide

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{Br}$

Formula Weight: 137.0

Melting Point:  $-112.4^{\circ}\text{C.}$

Boiling Point:  $101.6^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity: 1.277 to 1.299(20/4)

Refractive Index: 1.4398

Solubility: insoluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## 2-BROMOBUTANE

Synonyms: sec-butyl bromide  
 ethylmethylbromomethane

Formula:  $\text{C}_2\text{H}_5\text{CHBrCH}_3$

Characteristics: pleasant odor

Formula Weight: 137.0

Boiling Point:  $91.3^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity:  
 1.251(25/4) 1.2580(20/4)

Refractive Index: 1.4344 at  $25^{\circ}\text{C.}$

Solubility: insoluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

2-BROMO-tert-BUTYL PHENOL

Formula:  $(\text{CH}_3)_3\text{CC}_6\text{H}_3(\text{Br})\text{OH}$

Characteristics:  
 pale straw colored mild odor

Formula Weight: 229.1

Melting Point:  $<-20^{\circ}\text{C.}$

Boiling Point:  $109$  to  $129^{\circ}\text{C.}$  (at 5 mm.)

Specific Gravity: 1.338(25/25)

## Solubility:

insoluble in  $\infty$  (in carbon  
 water tetrachloride)  
 $\infty$  (in alcohol)  $\infty$  (in acetone)  
 $\infty$  (in ether)  $\infty$  (in benzene)

*d*-*dl*-BROMOBUTYRIC ACID

Synonyms: 2-bromobutanoic acid

Formula:  $C_2H_5CHBrCOOH$ 

Characteristics: oily

Formula Weight: 167.0

Melting Point:  $-4^{\circ}C$ .

Boiling Point:

212 to  $217^{\circ}C$ . (at 760 mm.) with decomposition181 to  $182^{\circ}C$ . (at 250 mm.)127 to  $128^{\circ}C$ . (at 25 mm.)

Specific Gravity: 1.567(20/20)

Uses: organic synthesis

Solubility (grams per 100 ml.):

6.6 (in water), soluble in alcohol  
cold soluble in ether

## 1,3-BROMOCHLOROBENZENE

Synonyms: *m*-bromochlorobenzeneFormula:  $ClC_6H_4Br$ 

Characteristics: oily

Formula Weight: 191.5

Melting Point:  $-21.2^{\circ}C$ .Boiling Point: 195 to  $196^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.6302(20/4)

Heat of Fusion (gram-calories per g.)

15.3 at  $15^{\circ}C$ .

Solubility: insoluble in water

very soluble in alcohol      very soluble in ether

## 1-BROMO-1-CHLOROETHANE

Synonyms: ethylidene chlorobromide  
1,1-bromochloroethaneFormula:  $CH_3CHClBr$ 

Formula Weight: 143.4

Melting Point:  $16.6^{\circ}C$ .Boiling Point:  $82.7^{\circ}C$ . (at 760 mm.)Specific Gravity: 1.667 at  $16^{\circ}C$ .

## 1-BROMO-2-CHLOROETHANE

Synonyms: 1,2-bromochloroethane  
ethylene chlorobromide  
chlorobromoethaneFormula:  $CH_2ClCH_2Br$ Characteristics: volatile  
sweet, chloroform-like odor

Formula Weight: 143.4

Freezing Point:  $-16.6^{\circ}C$ ;  $-18.4^{\circ}C$ .Boiling Point: 106.7 to  $108^{\circ}C$ . (at 760 mm.)  
 $106.1^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.689(17/4)       $1.720(25/25)$  $1.790$  at  $0^{\circ}C$ . $14.9$  lbs. per gal. at  $0^{\circ}C$ .Refractive Index:  $1.4864$  at  $25^{\circ}C$ .

Flash Point: none, open or closed

Uses:

solvent for cellulose ester and ethers  
organic synthesis

Solubility (grams per 100 ml.):

0.69 (in water at  $30^{\circ}C$ .       $\infty$  (in alcohol)  
 $\infty$  (in ether)0.7 (in water) at  $80^{\circ}C$ .       $\infty$  (in carbon tetrachloride)

miscible with most organic solvents

Additional Data: fire point, none

## BROMOCHLOROFLUOROMETHANE

Synonyms: fluorochlorobromomethane

Formula:  $CHClBrF$ 

Formula Weight: 174.4

Melting Point:  $<-65^{\circ}C$ .Boiling Point:  $38^{\circ}C$ . (at 760 mm.)Specific Gravity: 1.906 at  $16^{\circ}C$ .

## BROMOCHLOROMETHANE

Synonyms:

chlorobromomethane  
methylenebromochloride  
methylenchlorobromide

## BROMOCHLOROMETHANE (Cont.)

Formula:  $\text{CH}_2\text{BrCl}$ 

Formula Weight: 129.4

Melting Point:  $< -55^\circ\text{C}$ .Boiling Point:  $68$  to  $69^\circ\text{C}$ . (at  $760$  mm.)Specific Gravity: 1.991 at  $19^\circ\text{C}$ .

## 2-BROMO-1-CHLOROPROPANE

Formula:  $\text{CH}_3\text{CHBrCH}_2\text{Cl}$ 

Formula Weight: 157.5

Boiling Point:  $117.0^\circ\text{C}$ . (at  $756$  mm.)

Specific Gravity: 1.537(20/4)

Refractive Index: 1.4776

## 1-BROMO-2-CHLOROPROPANE

Formula:  $\text{CH}_3\text{CHClCH}_2\text{Br}$ 

Formula Weight: 157.5

Boiling Point:  $118.0^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.531(20/4)

Refractive Index: 1.4795

## 1-BROMO-3-CHLOROPROPANE

Synonyms:

3-chloro-1-bromopropane  
 trimethylene bromochloride  
 trimethylene chlorobromide

Formula:  $\text{CH}_2\text{ClCH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 157.5

Boiling Point:  $142$  to  $143^\circ\text{C}$ . (at  $760$  mm.)Specific Gravity: 1.63 at  $8^\circ\text{C}$ .Flash Point:  $25^\circ\text{F}$ . (open)

Solubility: insoluble in water

o-BROMO-*a*-CHLOROTOLUENE

Synonyms:

o-bromobenzyl chloride  
w-chloro-2-bromotoluene

Formula:  $\text{C}_6\text{H}_4\text{BrCH}_2\text{Cl}$ 

Formula Weight: 205.5

Boiling Point:  $124$  to  $126^\circ\text{C}$ . (at  $20$  mm.)

Solubility: insoluble in water  
                   very soluble in                    very soluble in  
                   alcohol                                   ether

p-BROMOCUMENESynonyms: p-bromoisopropylbenzeneFormula:  $\text{C}_6\text{H}_4\text{BrCH}(\text{CH}_3)_2$ 

Formula Weight: 199.1

Melting Point:  $< -20^\circ\text{C}$ .Boiling Point:  $216$  to  $218^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.365(22/4)

## BROMOCYCLOHEXANE

Synonyms: cyclohexyl bromide

Formula:  $\text{C}_6\text{H}_{11}\text{Br}$ 

Characteristics: penetrating odor

Formula Weight: 163.1

Boiling Point:  $163$  to  $165^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.324(20/20)  
                                   1.3290(15/15)

Refractive Index: 1.4956 at  $15^\circ\text{C}$ .

Solubility: insoluble in water  
                   very soluble in                    very soluble in  
                   alcohol                                   ether

2-BROMO-p-CYMENE

Synonyms:

2-bromocymene  
 2-bromo-4-isopropyl-1-methyl-benzen

Formula:  $(\text{CH}_3)_2\text{CHC}_6\text{H}_3\text{BrCH}_3$ 

Formula Weight: 213.1

Melting Point:  $< -20^\circ\text{C}$ :Boiling Point:  $233$  to  $235^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:  
                   1.253(25/25)                    1.269(17/4)

## Solubility (grams per 100 ml.):

insoluble in water	$\infty$ (in benzene)
very soluble in	$\infty$ (in acetone)
alcohol	50 (in methyl
very soluble in	alcohol) at
ether	25°C.

## 1-BROMO-1,1-DICHLOROETHANE

## Synonyms:

1,1-dichloro-1-bromoethane

Formula:  $\text{CH}_3\text{CCl}_2\text{Br}$ 

Formula Weight: 177.9

Boiling Point: 98 to 99°C. (at 758 mm.)

Specific Gravity: 1.752 at 16°C.

## 1-BROMO-2,2-DICHLOROETHANE

## Synonyms:

2,2-dichloro-1-bromoethane

Formula:  $\text{CHCl}_2\text{CH}_2\text{Br}$ 

Formula Weight: 177.9

Boiling Point: 138°C. (at 760 mm.)

## BROMODICHLOROMETHANE

## Synonyms: dichlorobromomethane

Formula:  $\text{CHCl}_2\text{Br}$ 

Formula Weight: 163.9

Melting Point: -56°C.

Boiling Point: 91 to 92°C. (at 760 mm.)

Specific Gravity: 1.925 at 15°C.

## 1-BROMO-2,2-DIFLUOROETHANE

Formula:  $\text{CH}_2\text{BrCHF}_2$ 

Formula Weight: 145.0

Melting Point: -74.5°C.

Boiling Point: 57.3°C. (at 760 mm.)

Specific Gravity: 1.824 at 18.5°C.

Solubility: slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## 1-BROMO-2,2-DIMETHYLPROPANE

## Synonyms: amyl bromide

Formula:  $(\text{CH}_3)_3\text{CCH}_2\text{Br}$ 

Formula Weight: 151.1

Boiling Point: 89 to 91°C. (at 749 mm.)

Specific Gravity: 1.260(20.4/4)

## Solubility: insoluble in water

soluble in alcohol soluble in ether

p-BROMODIPHENYL ETHERFormula:  $\text{BrC}_6\text{H}_4\text{OC}_6\text{H}_5$ 

Formula Weight: 249.1

Boiling Point: 305°C. (at 760 mm.)

Specific Gravity: 1.449 at 13°C.

## 1-BROMODODECANE

## Synonyms:

dodecyl bromide lauryl bromide

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{Br}$ 

Formula Weight: 249.2

Boiling Point: 175 to 180°C. (at 45 mm.)

## Solubility: insoluble in water

soluble in alcohol soluble in ether

## BROMOETHANE

## Synonyms:

bromic ether hydrobromic ether  
ethyl bromide monobromoethaneFormula:  $\text{C}_2\text{H}_5\text{Br}$ 

## Characteristics:

pleasant, ethereal odor  
sweetish, burning taste  
volatile

Formula Weight: 109.0

Melting Point: -119 to -117.8°C.

Freezing Point: -125°C.; -119°C.Boiling Point: 38.0 to 38.4°C. (at 760 mm.)  
37.5 to 39.5°C. (at 760 mm.)

## BROMOETHANE (Cont.)

## Specific Gravity:

1.424(25/25)      1.444(15.6/15.6)

1.430 to 1.450(20/4)

12.0 lbs. per gal. at 20°C.

Refractive Index: 1.4239; 1.4190 at 25°C.

## Surface Tension (dynes per cm.):

25.48 at 10°C.      24.15 at 20°C.

21.52 at 40°C.

Inflammability Range (volume per cent in air):

6.75 (lower limit)    11.25 (upper limit)

## Specific Heat:

0.22 (liquid) in calories per gram per °C. or Btu. per lb. at 5°C.

## Heat of Vaporization:

60.0 (gram-calories per gram)

108.0 (Btu. per lb. at the boiling point)

Heat of Combustion (kilogram-calories per mole): 340 (gas)

## Uses:

local anesthetic	dyes
refrigerant	organic synthesis
drugs	

## Solubility (grams per 100 ml.):

1.06 at 0°C.	∞ (in alcohol)
0.96 at 17.5°C.	∞ (in ether)
0.91 at 20°C.	∞ (in chloroform)
0.9 at 25°C.	∞ (in carbon tetrachloride).
(in water)	

## Additional Data:

colorless, turns yellow when exposed to light

critical temperature, 230.8°C.

critical pressure, 61.5 atm.

autoignition temperature, 952° F.

vapor density, 3.76

dielectric constant, 9.45 at 20°C.

a constant minimum boiling mixture of 7 moles of ethyl alcohol and 93 moles of ethyl bromide boils at 37.6°C.

bromoethane should be stored cool in tightly closed containers and away from light

## 2-BROMO-1-ETHANOL

## Synonyms:

$\beta$ -bromoethyl alcohol	glycol bromohydrin
ethylene bromohydrin	

Formula:  $\text{CH}_2\text{BrCH}_2\text{OH}$

Formula Weight: 125.0

## Boiling Point:

150.3°C. (at 760 mm.) slight decomposition

Specific Gravity: 1.7720(20/4)

Refractive Index: 1.4915

## Solubility:

soluble in water	∞ (in ether)
very soluble in alcohol	

 $\beta$ -BROMOETHYL ACETATE

Synonyms: 2-bromoethanol acetate

## Formula:

$\text{CH}_3\text{COOCH}_2\text{CH}_2\text{Br}$

Formula Weight: 167.0

Melting Point: -13.8°C.

## Boiling Point:

162 to 163°C.	161.5 to 164.5°C.
(at 760 mm.)	(at 760 mm.)

Specific Gravity: 1.514(20/4)

## Solubility:

insoluble in water	∞ (in alcohol)
	∞ (in ether)

d-BROMOETHYLBENZENE

## Synonyms:

1-bromo-1-phenylethane  
phenylethyl bromide  
methylphenylbromomethane

Formula:  $\text{C}_6\text{H}_5\text{CHBrCH}_3$

Formula Weight: 185.1

## Boiling Point:

200 to 210°C. (at 760 mm.) decomposes  
105 to 107°C. (at 30 mm.)

Specific Gravity: 1.3108(23/4)  
Solubility: insoluble in water  
soluble in alcohol      soluble in ether

β-BROMOETHYLBENZENE

Synonyms: 1-bromo-2-phenylethane  
Formula:  $C_6H_5CH_2CH_2Br$   
Formula Weight: 185.1  
Boiling Point: 217 to 218° C. (at 734 mm.)

X-BROMOETHYLBENZENE

Synonyms: Alkazene 40  
Formula:  $C_6H_4BrC_2H_5$   
Characteristics:  
colorless to pale      characteristic  
yellow      odor  
Formula Weight: 185.1  
Melting Point: -65° C.

Boiling Point:  
200.5 to 202.8° C. (at 760 mm.)  
Specific Gravity: 1.339(25/25)  
Viscosity (centipoises):  
1.4 at 25° C.      0.9 at 60° C.  
Flash Point: 199° F. (closed)  
Solubility:  
insoluble in water      ∞ (in carbon  
∞ (in ether)      tetrachloride)  
∞ (in methyl  
alcohol)

BROMOETHYLENE

Synonyms:  
bromoethene      vinyl bromide  
Formula:  $CH_2:CHBr$   
Formula Weight: 107.0  
Melting Point: -138° C.  
Boiling Point: 15.8° C. (at 760 mm.)  
Specific Gravity:  
1.529(11/4)      1.5167 at 14° C.

Refractive Index: 1.4462  
Solubility: insoluble in water  
∞ (in alcohol)      ∞ (in ether)

β-BROMOETHYL ETHYL ETHER

Synonyms:  
β-bromodiethyl ether  
1-bromo-2-ethoxyethane  
β-bromoethyl ether  
Formula:  $CH_2BrCH_2OC_2H_5$   
Formula Weight: 153.0  
Boiling Point: 126 to 129° C. (at 760 mm.)  
Specific Gravity:  
1.357(20/4)      1.370(0/4)  
Solubility:  
slightly soluble      ∞ (in alcohol)  
in water      ∞ ( in ether)

1-BROMO-4-FLUOROBENZENE

Synonyms: p-fluorobromobenzene  
Formula:  $FC_6H_4Br$   
Formula Weight: 175.0  
Melting Point:  
151.6° C.      152° C.  
(at 760 mm.)      (at 755 mm.)  
Boiling Point: -17.4 to -8° C.  
Specific Gravity:  
1.597(20/4)      1.593 at 15° C.  
Refractive Index: 1.5310 at 15° C.

Solubility:  
insoluble in water      very soluble in  
very soluble in      ether  
alcohol

BROMOFORM

Synonyms:  
formyl tribomide      tribromomethane  
methenyl tribromide  
Formula:  $CHBr_3$   
Characteristics:  
heavy chloroform-like odor and taste

## BROMOFORM (Cont.)

Formula Weight: 352.8

Melting Point:

6 to 90° C.                      4° C.

Boiling Point:

149.5 to 150.5° C.      147 to 151.2° C.  
(at 760 mm.)              (at 760 mm.)

Specific Gravity:

2.890(20/4)                  2.902(15/15)  
2.847(25/25)                  2.865(15.6/15.6)  
2.850 to 2.880(20/20)  
24 lbs. per gal.

Refractive Index:

1.5980 at 19° C.      1.6005 at 15° C.  
1.5906 at 25° C.Surface Tension (dynes per cm.): 41.53

Flash Point: none, open or closed

Heat of Fusion (gram-calories per g.):  
10.9 at 15° C.

Uses:

antispasmodic                  organic synthesis  
sedative                          geologic assays

Solubility (grams per 100 ml.):

0.319 at 30° C.                  soluble in petro-  
0.51 at 80° C.                  leum ether,  
(in water)                          carbon tetra-  
∞ (in alcohol)                      chloride, oils,  
∞ (in ether)                          acetone  
∞ (in chloroform)  
∞ (in benzene)

Additional Data:

should be stored in tightly closed con-  
tainers and away from light  
turns yellow slowly with decomposition  
dielectric constant, 4.5 at 20° C.  
fire point, none  
usually contains 3 to 4% alcohol

## 3-BROMOFURAN

Synonyms:

β-furyl bromide      2-bromofuranFormula: C<sub>4</sub>H<sub>3</sub>OBr

Formula Weight: 147.0

Boiling Point: 101 to 102° C. (at 760 mm.)

Specific Gravity: 1.650(20/4)

Refractive Index: 1.4981

Solubility:

insoluble in water      soluble in alcohol

## 1-BROMOHEPTANE

Synonyms: heptyl bromide

Formula: CH<sub>3</sub>(CH<sub>2</sub>)<sub>5</sub>CH<sub>2</sub>Br

Formula Weight: 179.1

Melting Point: -55.86° C.

Boiling Point:

178.8° C.                      178.5° C.  
(at 760 mm.)                  (at 751 mm.)

Specific Gravity: 1.133(16/4)

Solubility: insoluble in water

∞ (in alcohol)                  ∞ (in ether)

## 1-BROMOHEXANE

Synonyms: hexyl bromide

Formula: CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>CH<sub>2</sub>Br

Formula Weight: 165.1

Melting Point: -85.0° C.

Boiling Point:

156° C.                      155.5° C.  
(at 760 mm.)                  (at 744 mm.)

Specific Gravity:

1.1705(20/4)                  1.173 at 20° C.

Refractive Index: 1.4478

Solubility: insoluble in water

∞ (in alcohol)                  ∞ (in ether)

## 1-BROMO-2-IODOBENZENE

Synonyms: o-bromiodobenzeneFormula: BrC<sub>6</sub>H<sub>4</sub>I

Formula Weight: 282.9

Melting Point: 2.0 to 5.0° C.

Boiling Point:

257.4° C.                      124 to 127° C.  
(at 754 mm.)                  (at 17 mm.)

Specific Gravity: 2.257(25/4)  
Heat of Fusion (gram-calories per g.):  
12.2 at 15° C.  
Solubility:  
insoluble in water      very slightly sol-  
very slightly sol-      ule in acetic  
uble in alcohol      acid

1-BROMO-3-IODOBENZENE  
Synonyms: m-bromiodobenzene  
Formula: BrC<sub>6</sub>H<sub>4</sub>I  
Characteristics: oily  
Formula Weight: 282.9  
Melting Point: -9.3° C.  
Boiling Point: 252° C. (at 754 mm.)  
Heat of Fusion (gram-calories per g.):  
10.3 at 15° C.  
Solubility:  
insoluble in water      very slightly sol-  
very slightly sol-      ule in acetic  
uble in alcohol      acid

1-BROMO-1-IDOETHANE  
Synonyms: 1,1-bromiodoethane  
Formula: CH<sub>3</sub>CHBrI  
Formula Weight: 234.9  
Melting Point: <-20° C.  
Boiling Point: 142 to 143° C. (at 760 mm.)  
Specific Gravity: 2.452 at 16° C.

BROMOIODOMETHANE  
Formula: BrCH<sub>2</sub>I  
Formula Weight: 220.9  
Boiling Point: 138 to 140° C. (at 760 mm.)  
Specific Gravity: 2.296 at 17° C.

p-BROMOISOBUTYLBENZENE  
Formula: C<sub>6</sub>H<sub>5</sub>BrCH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub>  
Formula Weight: 213.1

Melting Point: <-18° C.  
Boiling Point: 232 to 233° C. (at 739 mm.)

x-BROMOISOPROPYLBENZENE  
Synonyms: Alkazene 47  
Formula: C<sub>6</sub>H<sub>4</sub>BrCH(CH<sub>3</sub>)<sub>2</sub>  
Characteristics: characteristic odor  
Formula Weight: 199.1  
Melting Point: -30° C.  
Boiling Point: -  
212.4 to 216.2° C. (at 760 mm.)  
Specific Gravity: 1.294(25/25)  
Flash Point: 205° F. (closed)  
Solubility:  
insoluble in water      ∞ (in carbon  
∞ (in ether)      tetrachloride)  
∞ (in methyl  
alcohol)

2-BROMOMESITYLENE  
Formula: (CH<sub>3</sub>)<sub>3</sub>C<sub>6</sub>H<sub>2</sub>Br  
Formula Weight: 199.1  
Melting Point: -1° C.  
Boiling Point: 225 to 230° C. (at 760 mm.)  
Specific Gravity: 1.319 at 10° C.

BROMOMETHANE  
Synonyms:  
methyl bromide      monobromo-  
methane  
Formula: CH<sub>3</sub>Br  
Characteristics:  
volatile      chloroform-like  
burning taste      odor  
Formula Weight: 95.0  
Melting Point: -93.66° C.

## BROMOMETHANE (Cont.)

## Boiling Point:

3.56° C.	4.5° C.
(at 760 mm.)	(at 758 mm.)
4.5° C.	20.0° C.
(at 4.7 lbs.)	(at 24.2 lbs.)
40.0° C. (at 44.5 lbs.)	

## Specific Gravity: 1.732(0/0)

14.4 lbs. per gal. at 0° C.

## Inflammability Range (volume per cent in air):

13.5 (lower limit) 14.5 (upper limit)

## Flash Point: none

## Heat of Combustion (kilogram-calories per mole): 184

## Uses:

refrigerant                      organic syntheses  
 fumigant                        low boiling solvent  
 manufacture of dyes  
 and pharmaceuticals

## Solubility (grams per 100 ml.):

0.09 (in water at 20° C.)  
 very soluble in alcohol  
 very soluble in ether  
 soluble in chloroform  
 soluble in carbon disulfide  
 soluble in benzene

## Additional Data:

miscible with most organic solvents  
 forms a voluminous crystalline hydrate  
 with cold water  
 nonflammable  
 vapor density, 3.27  
 thermal conductivity, 0.574 at 0° C.  
 heat capacity, 1.27 at 16° C.  
 (0.3 to 0.6 atm.)  
 critical temperature, 194° C.  
 dielectric constant, 0.0068 at 100° F.  
 critical pressure, 51.6 atm.

## BROMOMETHYL ACETATE

Formula:  $\text{CH}_3\text{COOCH}_2\text{Br}$ 

Formula Weight: 153.0

Boiling Point: 110 to 112° C.

Specific Gravity: 1.195 at 14° C.

## Solubility:

insoluble in water, slight decom-  
 position  
 soluble in alcohol      soluble in ether

## 1-BROMO-2-METHYLBUTANE

Synonyms: d-prim-act-amyl bromide

## Formula:



Formula Weight: 151.1

## Boiling Point:

120 to 121° C.                      121° C.  
 (at 760 mm.)                      (at 755 mm.)

Specific Gravity: 1.221(20/4)

## Solubility: insoluble in water

soluble in alcohol      soluble in ether

## 2-BROMO-2-METHYLBUTANE

Synonyms: tert-amyl bromideFormula:  $(\text{CH}_3)_2\text{CBrCH}_2\text{CH}_3$ 

Formula Weight: 151.1

Boiling Point: 108° C. (at 756 mm.)

Specific Gravity: 1.216(19/6)

## Solubility: insoluble in water

soluble in alcohol      soluble in ether

## 1-BROMO-3-METHYLBUTANE

Synonyms: isoamyl bromide

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 151.1

Melting Point: -111.9° C.

## Boiling Point:

120.4° C.                      120.65° C.  
 (at 745 mm.)                      (at 760 mm.)

Specific Gravity: 1.220(17/15)

Refractive Index: 1.4412

## Solubility (grams per 100 ml.):

0.02 (in cold water)      soluble in alcohol  
 16.5 (in hot water)      soluble in ether

4-BROMO-7-METHYLINDENE

Synonyms:  
methyl-4-bromohydindene (7)  
Formula:  $\text{CH}_3\text{C}_6\text{H}_2\text{Br}(\text{CH}_2)_3$   
Characteristics: pale yellow  
Formula Weight: 211.1  
Boiling Point: 120 to 122° C. (at 10 mm.)  
Solubility: insoluble in water  
slightly soluble in alcohol      soluble in ether

5-BROMO-2-METHYLPENTANE

Synonyms:  
hexyl bromide      isohexyl bromide  
Formula:  
 $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{Br}$   
Formula Weight: 165.1  
Boiling Point: 146.7° C. (at 760 mm.)  
Specific Gravity: 1.168 at 20° C.

1-BROMO-2-METHYLPROPANE

Synonyms: isobutyl bromide  
Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{Br}$   
Formula Weight: 137.0  
Melting Point: -118.5° C.  
Boiling Point: 91.5° C. (at 760 mm.)  
Specific Gravity:  
1.264      1.258(25/4)  
Refractive Index: 1.436  
Solubility (grams per 100 ml.):  
0.0589 (in water)      ∞ (in alcohol)  
at 16° C.      ∞ (in ether)

2-BROMO-2-METHYLPROPANE

Synonyms:  
bromotrimethyl-      tert-butyl bromide  
methane  
Formula:  $(\text{CH}_3)_3\text{CBr}$   
Formula Weight: 137.0

Melting Point: -20 to -16.2° C.  
Boiling Point:  
73.3° C.      decomposes at  
(at 760 mm.)      210° C.  
Specific Gravity: 1.222(20/4)  
Refractive Index: 1.428  
Solubility:  
insoluble in water      miscible with  
∞ (in alcohol)      many organic  
∞ (in ether)      solvents  
Additional Data:  
changes at 210° C. to 1-bromo-*ω*-  
methylpropane

1-BROMONAPHTHALENE

Synonyms:  
*α*-bromo-      *α*-naphthyl  
naphthalene      bromide  
Formula:  $\text{C}_{10}\text{H}_7\text{Br}$   
Characteristics: oily  
Formula Weight: 207.1  
Melting Point:  
5 to 6.2° C.      5.5° C.  
Boiling Point:  
281.1° C.      146 to 149° C.  
(at 760 mm.)      (at 16 mm.)  
Specific Gravity: 1.482 to 1.4875(20/4)  
Refractive Index:  
1.6588 at 19.4° C.      1.6601 at 17° C.  
Solubility: insoluble in cold water  
soluble in hot water      ∞ (in ether)  
∞ (in absolute      ∞ (in benzene)  
alcohol)

1-BROMO-1-NITROETHANE

Formula:  $\text{CH}_3\text{CHBrNO}_2$   
Formula Weight: 154.0  
Boiling Point: 146 to 147° C. (at 760 mm.)  
Solubility: insoluble in water

## BROMONITROMETHANE

Formula:  $\text{BrCH}_2\text{NO}_2$ 

Formula Weight: 140.0

Boiling Point:  $152.5^\circ\text{C}$ . (at 765 mm.)

Uses:

imbedding compound for microscopical tests

Solubility:

insoluble in water    soluble in alkalies

## 2-BROMONONANE

Synonyms: nonyl bromide (2)

Formula:  $\text{C}_7\text{H}_{15}\text{CHBrCH}_3$ 

Formula Weight: 207.2

Boiling Point:

 $208$  to  $209^\circ\text{C}$ . (at 767 mm.)  
decomposesSpecific Gravity: 1.081 at  $20^\circ\text{C}$ .

## 1-BROMOOCTANE

Synonyms:

capryl bromide    octyl bromide  
caprylic bromide    octylic bromide  
octoic bromideFormula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{Br}$ 

Formula Weight: 193.1

Melting Point:  $-55^\circ\text{C}$ .Boiling Point:  $202$  to  $203^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.118(20/4)    1.1160(15/4)

Refractive Index: 1.4503 at  $25^\circ\text{C}$ .

Uses: organic syntheses

Solubility: insoluble in water

 $\infty$  (in alcohol)     $\infty$  (in ether)

## 2-BROMOOCTANE

Synonyms: 1-sec-octyl bromide

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CHBrCH}_3$ 

Formula Weight: 193.1

Boiling Point:

 $188$  to  $191^\circ\text{C}$ .     $91$  to  $93^\circ\text{C}$ .  
(at 760 mm.)    (at 20 mm.)Specific Gravity: 1.099 at  $22^\circ\text{C}$ .

Solubility: insoluble in water

 $\infty$  (in alcohol)     $\infty$  (in ether)

## 1-BROMOPENTADECANE

Synonyms: pentadecyl bromide

Formula:  $\text{CH}_3(\text{CH}_2)_{13}\text{CH}_2\text{Br}$ 

Formula Weight: 291.3

Melting Point:  $14$  to  $15^\circ\text{C}$ .

Solubility:

decomposes in    slightly soluble  
water    in ether  
decomposes in  
alcohol

## 1-BROMOPENTANE

Synonyms: amyl bromide

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{Br}$ 

Formula Weight: 151.1

Melting Point:  $-88^\circ\text{C}$ .Boiling Point:  $128$  to  $129^\circ\text{C}$ . (at 740 mm.)

Specific Gravity:

1.246(0/4)    1.218(20/4)

Refractive Index: 1.444

Solubility: insoluble in water

soluble in alcohol     $\infty$  (in ether)o-BROMOPHENETOLE

Synonyms: bromophenyl ethyl ether

Formula:  $\text{BrC}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 201.1

Boiling Point:  $218$  to  $222^\circ\text{C}$ . (at 760 mm.)

Solubility:

soluble in alcohol    soluble in ether

p-BROMOPHENETOLEFormula:  $\text{BrC}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 201.1

Melting Point:  $4^\circ\text{C}$ .Boiling Point:  $227$  to  $233^\circ\text{C}$ . (at  $760\text{ mm.}$ ) $\beta$ -BROMOPHENETOLESynonyms:  $\beta$ -bromoethyl phenyl etherFormula:  $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 201.1

Melting Point:  $30$  to  $31^\circ\text{C}$ .

Boiling Point:

 $240$  to  $250^\circ\text{C}$ . (at  $760\text{ mm.}$ ), decomposes

Solubility:

very slightly soluble in water      soluble in alcohol and ether

o-BROMOPHENOLFormula:  $\text{BrC}_6\text{H}_4\text{OH}$ 

Characteristics:

yellow to red      unpleasant odor

Formula Weight: 173.0

Melting Point:  $4$  to  $6^\circ\text{C}$ .Boiling Point:  $194$  to  $195^\circ\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity: 1.4924(20/4)

Uses: antiseptic

Solubility:

slightly soluble in water       $\infty$  (in ether)  
 $\infty$  (in chloroform)  
soluble in alcohol      soluble in alkalies

## BROMOPICRIN

Synonyms:

nitrobromoform      tribromonitromethane

Formula:  $\text{NO}_2\text{CBr}_3$ 

Formula Weight: 297.8

Melting Point:  $10.3^\circ\text{C}$ .Boiling Point:  $127^\circ\text{C}$ . (at  $188\text{ mm.}$ )

Specific Gravity:

2.811(12.5/4)      2.79 at  $18^\circ\text{C}$ .Refractive Index: 1.5831 at  $13^\circ\text{C}$ .

Uses: organic syntheses

Solubility: insoluble in water

soluble in alcohol, ether, and benzene

Additional Data:

decomposes violently on rapid heating  
highly irritating and poisonous

## 1-BROMOPROPANE

Synonyms: propyl bromide

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 123.0

Melting Point:  $-109.9^\circ\text{C}$ .Boiling Point:  $70.9^\circ\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity: 1.353(20/4)

Refractive Index: 1.43414

Solubility (grams per 100 ml.):

0.25 in water       $\infty$  (in alcohol)  
at  $20^\circ\text{C}$ .       $\infty$  (in ether)

## 2-BROMOPROPANE

Synonyms: isopropyl bromide

Formula:  $\text{CH}_3\text{CHBrCH}_3$ 

Formula Weight: 123.0

Melting Point:  $-89.0^\circ\text{C}$ .

Boiling Point:

 $59.6$  to  $60^\circ\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity: 1.310(20/4)

Refractive Index: 1.42508

Solubility (grams per 100 ml.):

0.32 in water       $\infty$  (in ether)  
at  $20^\circ\text{C}$ .       $\infty$  (in chloroform)  
 $\infty$  (in alcohol)       $\infty$  (in benzene)

## 2-BROMO-1-PROPANOL

## Synonyms:

$\beta$ -bromopropyl      prim-propylene  
alcohol                  bromohydrin

Formula:  $\text{CH}_3\text{CHBrCH}_2\text{OH}$ 

Formula Weight: 139.0

Boiling Point: 52 to 53°C. (at 16 mm.)

## 3-BROMO-1-PROPANOL

## Synonyms:

trimethylene bromohydrin

Formula:  $\text{CH}_2\text{BrCH}_2\text{CH}_2\text{OH}$ 

Formula Weight: 139.0

Boiling Point: 98 to 112°C. (at 185 mm.)

Specific Gravity: 1.5710(20/4)

Solubility (grams per 100 ml.):

16.6 in water                   $\infty$  (in alcohol)  
    $\infty$  (in ether)

## 1-BROMO-2-PROPANONE

Synonyms: bromoacetone, BA

Formula:  $\text{CH}_2\text{BrCOCH}_3$ 

## Characteristics:

poisonous                  colorless to  
pungent odor              yellow brown

Formula Weight: 137.0

Melting Point: -54°C.

Boiling Point: 136.5°C. (at 785 mm.)

Vapor Pressure (mm. Hg.): 9 at 20°C.

Specific Gravity:

1.634 at 23°C.              1.631 at 0°C.

Uses: organic syntheses

## Solubility:

slightly soluble in water  
slightly soluble in alcohol  
very soluble in ether  
soluble in benzene  
soluble in acetaldehyde

Additional Data: vapor density, 4.75

## 1-BROMOPROPENE

## Synonyms:

1-bromo-1-                  propenyl bromide  
propene  
1, $\alpha$ -bromo-  
propylene

Formula:  $\text{CH}_3\text{CH:CHBr}$ 

Formula Weight: 121.0

Melting Point: -116.6 to -113°C.

Boiling Point: 59 to 62°C. (at 760 mm.)

Specific Gravity:

1.434(15.8/4)              1.428 at 19.5°C.

Refractive Index: 1.4554

## 2-BROMOPROPENE

## Synonyms:

2-bromopropenyl          isopropenyl  
   bromide

Formula:  $\text{CH}_3\text{CBr:CH}_2$ 

Formula Weight: 121.0

Melting Point: -125°C.

Boiling Point: 48.6°C. (at 760 mm.)

Specific Gravity: 1.397(15.8/4)

## 3-BROMOPROPENE

## Synonyms:

allyl bromide              3-bromo-1-  
   propene

Formula:  $\text{CH}_2\text{:CH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 121.0

Melting Point: -119.4°C.

Boiling Point: 71.3°C. (at 760 mm.)

Specific Gravity: 1.398(20/4)

Refractive Index: 1.4655

Solubility: insoluble in water

$\infty$  (in alcohol)               $\infty$  (in ether)  
soluble in chloroform, carbon disulfide  
and carbon tetrachloride

**2-BROMO-2-PROPEN-1-OL**Synonyms:  $\beta$ -bromoallyl alcoholFormula:  $\text{CH}_2\text{:CBrCH}_2\text{OH}$ 

Formula Weight: 137.0

Boiling Point: 152 to 154°C. (at 760 mm.)

Specific Gravity: 1.6 at 15°C.

 **$\alpha$ -BROMO( $d$ ,  $\ell$ )PROPIONIC ACID**

Synonyms:

 $d\ell$ -2-bromopropanoic acidFormula:  $\text{CH}_3\text{CHBrCOOH}$ 

Formula Weight: 153.0

Melting Point: 25.7°C.

Boiling Point: 203.5°C. (at 760 mm.)

Specific Gravity: 1.700

Refractive Index: 1.4753

Uses: organic syntheses

Solubility:

very soluble in water          soluble in ether

very soluble in alcohol

 **$\alpha$ -BROMOPROPIONYL BROMIDE**Formula:  $\text{CH}_3\text{CHBrCOBr}$ 

Formula Weight: 215.9

Boiling Point: 152 to 154°C. (at 760 mm.)

Specific Gravity: 2.061(16/4)

 **$\beta$ -BROMOPROPYL ACETATE**Formula:  $\text{CH}_3\text{COOCH}_2\text{CHBrCH}_3$ 

Formula Weight: 181.0

Boiling Point: 51 to 53°C. ( at 9 mm.)

 **$\gamma$ -BROMOPROPYL ACETATE**

Formula:

 $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 181.0

Boiling Point: 88 to 90°C. (at 22 mm.)

 **$p$ -BROMOPROPYLBENZENE**Formula:  $\text{BrC}_6\text{H}_4\text{CH}_2\text{CH}_2\text{CH}_3$ 

Formula: 199.1

Boiling Point: 220°C. (at 760 mm.)

 **$\gamma$ -BROMOPROPYL BENZENE**Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 199.1

Boiling Point: 121 to 122°C. (at 20 mm.)

 **$\gamma$ -BROMOPROPYL PHENYL ETHER**Formula:  $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_2\text{CH}_2\text{Br}$ 

Formula Weight: 215.1

Boiling Point: 211 to 212°C. (at 200 mm.)

Specific Gravity: 1.365(16/16)

**3-BROMOPROPYNE**

Synonyms:

 $\gamma$ -bromoallylene      propargyl bromide  
3-bromo-1-propyneFormula:  $\text{CH}_3\text{CCH}_2\text{Br}$ 

Formula Weight: 119.0

Boiling Point: 88 to 90°C. (at 760 mm.)

Specific Gravity: 1.520 at 20°C.

**2-BROMOPYRIDINE**Synonyms:  $\alpha$ -bromopyridineFormula:  $\text{BrC}_5\text{H}_4\text{N}$ 

Formula Weight: 158.0

Boiling Point: 193 to 194°C. (at 760 mm.)

Specific Gravity: 1.657 at 15°C.

Solubility: slightly soluble in water

## 3-BROMOPYRIDINE

Synonyms:  $\beta$ -bromopyridineFormula:  $\text{BrC}_5\text{H}_4\text{N}$ 

Characteristics: oily

Formula Weight: 158.0

Boiling Point:

169 to 173.4° C. (at 760 mm.)	173 to 174° C. (at 758 mm.)
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Specific Gravity:

1.632 at 10° C.	1.645(0/4)
-----------------	------------

Solubility:

slightly soluble in water	very soluble in ether
very soluble in alcohol	

 $\alpha$ -BROMOSTYRENE

Synonyms:

1-bromo-1-phenylethylene  
 $\alpha$ -bromostyrol  
 ( $\alpha$ -bromovinyl) benzene

Formula:  $\text{C}_6\text{H}_5\text{CBr}:\text{CH}_2$ 

Characteristics: oily

Formula Weight: 183.1

Melting Point: -43.5° C.

Boiling Point:

160° C. (at 75 mm.)	86 to 87° C. (at 14 mm.)
------------------------	-----------------------------

Specific Gravity: 1.406(20/4)

Refractive Index: 1.5881 at 19.5° C.

 $\beta$ -BROMOSTYRENE (I)

Synonyms:

1-bromo-2-phenyl- ( $\beta$ -bromovinyl)  
 ethylene benzene  
 $\omega$ -bromostyrene

Formula:  $\text{C}_6\text{H}_5\text{CH}:\text{CHBr}$ 

Formula Weight: 183.1

Melting Point: 7° C.

Boiling Point:

219 to 221° C. (at 760 mm.) slight decomposition

Specific Gravity:

1.422(20/4)	1.4269 at 16° C.
-------------	------------------

Refractive Index: 1.6094 at 20.5° C.

Solubility: insoluble in water

$\infty$ (in alcohol)	$\infty$ (in ether)
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 $\beta$ -BROMOSTYRENE (II)

Synonyms:

1-bromo-2-phenyl- ( $\beta$ -bromovinyl)  
 ethylene benzene  
 $\omega$ -bromostyrene

Formula:  $\text{C}_6\text{H}_5\text{CH}:\text{CHBr}$ 

Formula Weight: 183.1

Melting Point: -8 to -7° C.

Boiling Point:

108° C. (at 26 mm.)	71° C. (at 6 mm.)
------------------------	----------------------

Specific Gravity:

1.427(20/4)	1.4322 at 16° C.
-------------	------------------

Refractive Index: 1.5990 at 22° C.

## 1-BROMOTETRADECANE

Synonyms: myristyl bromide

Formula:  $\text{CH}_3(\text{CH}_2)_{12}\text{CH}_2\text{Br}$ 

Formula Weight: 277.3

Melting Point: 3 to 5° C.

Solubility:

insoluble in water soluble in ether

 $\alpha$ -BROMOTOLUENE

Synonyms: benzyl bromide

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$ 

Characteristics:

refractive	pleasant odor
poisonous	

Formula Weight: 171.0

Melting Point: -4.0° C.

Boiling Point: 198 to 199° C. (at 760 mm.)

Specific Gravity:

1.438(22/0)                      1.443 at 17° C.

Uses:

organic syntheses      military poison  
yeast antiseptic          gas  
manufacture of foaming and frothing  
agents

Solubility: insoluble in water

∞ (in alcohol)                  soluble in benzene

∞ (in ether)

Additional Data: vapor density, 5.8

### m-BROMOTOLUENE

Synonyms:

m-monobromo-              3-bromotoluene  
toluene

m-tolyl bromide

Formula:  $\text{BrC}_6\text{H}_4\text{CH}_3$

Formula Weight: 171.0

Melting Point: -39.8° C.

Boiling Point: 183.7° C. (at 760 mm.)

Specific Gravity: 1.410(20/4)

Refractive Index: 1.551

Solubility: insoluble in water

soluble in                      ∞ (in ether)  
alcohol                          ∞ (in benzene)

### o-BROMOTOLUENE

Synonyms:

o-monobromo-              2-bromotoluene  
toluene

o-tolyl bromide

Formula:  $\text{BrC}_6\text{H}_4\text{CH}_3$

Formula Weight: 171.0

Melting Point: -29 to -26° C.

Boiling Point: 181.8° C. (at 760 mm.)

Specific Gravity:

1.431(15/15)                      1.422(20/4)

Refractive Index: 1.555

Solubility:

insoluble in water      very soluble in  
very soluble in          ether  
alcohol                      ∞ (in benzene)

### 1-BROMO-2,2,2-TRICHLOROETHANE

Synonyms:

1,2,2,2-trichlorobromoethane

Formula:  $\text{CH}_2\text{BrCCl}_3$

Formula Weight: 212.3

Boiling Point: 151 to 153° C. (at 760 mm.)

Specific Gravity: 1.884

### BROMOTRICHLOROMETHANE

Synonyms: trichlorobromomethane

Formula:  $\text{BrCCl}_3$

Formula Weight: 198.3

Melting Point: -21° C.

Boiling Point: 104.1° C. (at 760 mm.)

Specific Gravity:

2.055(0/4)                      1.959 at 15° C.

Refractive Index: 1.5300

Solubility: insoluble in water

∞ (in alcohol)                  ∞ (in ether)

### BROMOTRINITROMETHANE

Formula:  $\text{BrC}(\text{NO}_2)_3$

Formula Weight: 230.0

Melting Point: <12° C.

Boiling Point:

decomposes at 140° C. (at 760 mm.)

Specific Gravity: 2.8

Solubility: insoluble in water

### d-BROMOVALERIC ACID

Synonyms: 2-bromopentanoic acid

Formula:

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHBrCOOH}$

Formula Weight: 181.0

$\alpha$ -BROMOVALERIC ACID (Cont.)

Boiling Point:

126 to 130° C.

(at 27 mm.)

67° C.

(at 10 mm.)

Solubility:

slightly soluble  
in water

soluble in ether

very soluble in  
alcohol2-BROMO-m-XYLENE

Synonyms: 2-bromo-1,3-xylene

Formula:  $\text{BrC}_6\text{H}_3(\text{CH}_3)_2$ 

Formula Weight: 185.1

Melting Point: &lt; -10° C.

Boiling Point: 206±° C. (at 760 mm.)

Solubility: insoluble in water

2-BROMO-p-XYLENE

Synonyms: 2-bromo 1,4-xylene

Formula:  $\text{BrC}_6\text{H}_3(\text{CH}_3)_2$ 

Formula Weight: 185.1

Melting Point: 9 to 10° C.

Boiling Point:

206.7° C.

(at 760 mm.)

205.5° C.

(at 755 mm.)

Specific Gravity: 1.356(20/4)

3-BROMO-o-XYLENE

Synonyms: 3-bromo-1,2-xylene

Formula:  $\text{BrC}_6\text{H}_3(\text{CH}_3)_2$ 

Formula Weight: 185.1

Melting Point: &lt; -10° C.

Boiling Point: 213 to 214° C. (at 760 mm.)

Specific Gravity: 1.365(20/4)

Solubility: insoluble in water

4-BROMO-m-XYLENE

Synonyms:

4-bromo-1,3-xylene

asym-bromo-m-xyleneFormula:  $\text{BrC}_6\text{H}_3(\text{CH}_3)_2$ 

Formula Weight: 185.1

Boiling Point: 203 to 207° C. (at 760 mm.)

Solubility:

insoluble in  
watervery soluble in  
ethervery soluble in  
alcohol4-BROMO-o-XYLENE

Synonyms:

4-bromo-1,2-xylene

asym-bromo-2-xyleneFormula:  $\text{BrC}_6\text{H}_3(\text{CH}_3)_2$ 

Formula Weight: 185.1

Melting Point: -2° C.

Boiling Point: 214.5° C. (at 760 mm.)

Specific Gravity: 1.369(15/15)

Solubility:

insoluble in  
watervery soluble in  
ethervery soluble in  
alcohol5-BROMO-m-XYLENE

Synonyms: 5-bromo-1,3-xylene

Formula:  $\text{BrC}_6\text{H}_3(\text{CH}_3)_2$ 

Formula Weight: 185.1

Melting Point: &lt; -20° C.

Boiling Point: 204° C. (at 760 mm.)

 $\alpha$ -BROMO-m-XYLENE

Synonyms:

 $\omega$ -bromo-m-  
xylenem-xylyl bromidFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{Br}$

Formula Weight: 185.1

Boiling Point:

212 to 215°C. (at 760 mm.) slight decomposition

Specific Gravity: 1.371 at 25°C.

Solubility:

insoluble in water	very soluble in ether
very soluble in alcohol	

### *o*-BROMO-*o*-XYLENE

Synonyms:

<u><i>o</i></u> -bromo- <u><i>o</i></u> -xylene	<u><i>o</i></u> -xylyl bromide
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Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{Br}$

Formula Weight: 185.1

Melting Point: 21°C.

Boiling Point:

223 to 224°C. (at 760 mm.)	217.7°C. (at 760 mm.)
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Specific Gravity: 1.381(23/4)

Solubility:

insoluble in water	very soluble in ether
soluble in alcohol	

### 1,2-BUTADIENE

Synonyms: methylallene

Formula:  $\text{CH}_3\text{CH}:\text{C}:\text{CH}_2$

Formula Weight: 54.1

Boiling Point: 18 to 19°C. (at 760 mm.)

Solubility: insoluble in water

$\infty$ (in alcohol)	$\infty$ (in ether)
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### 1,3-BUTANEDIAMINE

Synonyms: 1,3-diaminobutane

Formula:

$\text{NH}_2\text{CH}_2\text{CH}_2\text{CHNH}_2\text{CH}_3$

Characteristics: amine odor

Formula Weight: 88.2

Boiling Point: 143 to 150°C. (at 760 mm.)

Specific Gravity: 0.858(20/20)

Refractive Index: 1.450

Flash Point: 125°F. (open)

Solubility:

soluble in water, methyl alcohol, ether, acetone, benzene, gasoline, and ethyl acetate

### 1,2-BUTANEDIOL

Synonyms:

<u><i>o</i></u> -butylene glycol	ethylethylene
1,2-dihydroxybutane	glycol

Formula:

$\text{CH}_3\text{CH}_2\text{CHOHCH}_2\text{OH}$

Formula Weight: 90.1

Boiling Point: 192 to 194°C. (at 760 mm.)

Specific Gravity:

1.019(0/4)	1.006(17.5/0)
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Flash Point: 104°F. (closed)

Solubility:

slightly soluble in water	very soluble in alcohol
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Additional Data: vapor density, 3.10

### 1,3-BUTANEDIOL

Synonyms:

<u><math>\beta</math></u> -butylene glycol	<u><i>o</i></u> -methyltri-
1,3-dihydroxybutane	methylene glycol

Formula:

$\text{CH}_3\text{CHOHCH}_2\text{CH}_2\text{OH}$

Characteristics: viscous

Formula Weight: 90.1

Boiling Point:

204 to 206.5°C. (at 760 mm.)

Specific Gravity

1.006(20/20)	1.0259(20/4)
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## 1,3-BUTANEDIOL (Cont.)

## Solubility:

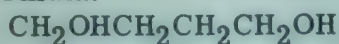
very soluble in water  
 very soluble in alcohol  
 insoluble in ether

## 1,4-BUTANEDIOL

## Synonyms:

1,4-dihydroxy- butane  
 tetramethylene glycol

## Formula:



Characteristics: oily

Formula Weight: 90.1

Melting Point: 16°C.

Boiling Point: 230°C. (at 760 mm.)

Specific Gravity: 1.020(20/4)

## Solubility:

∞ (in water)  
 soluble in alcohol  
 very slightly soluble in ether

## 2,3-BUTANEDIOL

## Synonyms:

2,3-dihydroxybutane  
 sym-dimethylethylene glycol  
 pseudobutylene glycol

Formula:  $\text{CH}_3\text{CHOHCHOHCH}_3$ 

Formula Weight: 90.1

Melting Point: 21 to 23°C.

## Boiling Point:

182.0°C.  
 (at 760 mm.)  
 183 to 184°C.  
 (at 760 mm.)

Specific Gravity: 1.048(0/4)

## Solubility:

∞ (in water)  
 very soluble in alcohol  
 ∞ (in ether)

## 1-BUTANETHIOL

Synonyms: butyl mercaptan

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{SH}$ 

Characteristics: mercaptan odor

Formula Weight: 90.2

Melting Point: -116°C.

## Boiling Point:

97 to 98°C.  
 (at 760 mm.)  
 79 to 80.5°C.  
 (at 760 mm.)

## Specific Gravity:

0.8365(25/4)  
 0.83720  
 0.858(0/4)  
 0.841(20/20)

## Refractive Index:

1.443 at 20°C.  
 1.440 at 25°C.

Flash Point: 35°F. (closed)

Uses: warning agent

Solubility: slightly soluble in water

very soluble in alcohol  
 very soluble in ether

## 2-BUTANETHIOL

Formula:  $\text{C}_4\text{H}_{10}\text{S}$ 

Formula Weight: 90.2

Melting Point: -165°C.

Boiling Point: 84.5°C. (at 760 mm.)

## Specific Gravity:

0.829 at 20°C.  
 0.824 at 25°C.

Refractive Index: 1.434 at 25°C.

## 2-BUTANONE

## Synonyms:

butanone  
 ethyl methyl ketone  
 methyl ethyl ketone

Formula:  $\text{CH}_3\text{COC}_2\text{H}_5$ 

Characteristics: acetone-like odor

Formula Weight: 72.1

## Melting Point:

-86.4°C.  
 -85.9°C.

## Boiling Point:

79 to 80.5° C. (at 760 mm.)

77 to 82° C. (at 760 mm.)

79.6° C. (at 760 mm.)

## Specific Gravity:

0.8047(20/4)

0.808

6.72 lbs. per gal. at 20° C.

## Refractive Index:

1.3807 at 15.9° C.

1.3791 at 20° C.

## Surface Tension (dynes per cm.):

24.6 at 20° C.

## Viscosity (centipoises): 0.401 at 25° C.

## Inflammability Range (volume per cent in air):

1.97 (lower limit)

10.2 (upper limit)

## Flash Point:

34° F. (open)

30° F. (closed)

28° F. (closed)

## Specific Heat (gram-calories per g. per ° C.):

0.550 (liquid) at 20 to 78° C.

## Heat of Vaporization (gram-calories per g.): 106 at 20° C.

## Uses:

smokeless powder      chemical inter-  
   dopes                        mediate  
 lacquers                        dewaxing agent in  
 celluloid                        refining oils  
 artificial leather            organic syntheses  
   dressing                acetone sub-  
 dyes                                stitute  
 good solvent for nitrocellulose but not  
   for most types of cellulose acetate  
 solvent in the manufacture of plastics,  
   and in the printing and lithographing  
   industries

## Solubility (grams per 100 ml.):

12.5 (of water)      ∞ (in ether)

27 (in water)      ∞ (in benzene)

∞ (in alcohol)

miscible with oils

forms azeotropic mixtures with sev-  
   eral common lacquer solvents  
 azeotrope with water contains 88.7%  
   of butanone and boils at 73.4° C.

## Additional Data:

dielectric constant, 18.4

vapor density, 2.5

weight of pure vapor, 320 mg. per l.

coefficient of expansion,

0.00076 per ° F.      0.00128 at 10 to 30° C.

## Composition in Two-Phase System

2-Butanone-Water at 20° C.

	2-Butanone	Water
	wt. %	wt. %
Lower layer . . .	27.0 . . .	73.0
Upper layer . . .	87.5 . . .	12.5

## 2-BUTANONE OXIME

## Synonyms:

butanoxime

methyl ethyl

ethyl methyl

ketoxime

ketoxime

Formula:  $\text{CH}_3\text{C}(\text{:NOH})\text{C}_2\text{H}_5$ 

Formula Weight: 87.1

Melting Point: -29.5° C.

Boiling Point: 152 to 153° C. (at 760 mm.)

Specific Gravity: 0.923(20/4)

Refractive Index: 1.4428

Solubility (grams per 100 ml.):

10 (in water)      ∞ (in ether)

∞ (in alcohol)

## 3-BUTENENITRILE

## Synonyms:

allyl cyanide

vinylaceto-

 $\beta$ -butenonitrile

nitrile

Formula:  $\text{CH}_2\text{:CHCH}_2\text{CN}$ 

Formula Weight: 67.1

Boiling Point: 116 to 119° C. (at 760 mm.)

Specific Gravity: 0.8318(20/4)

Refractive Index: 1.4060

## Solubility:

very slightly sol-      ∞ (in ether)

uble in water

∞ (in alcohol)

## 3-BUTENOIC ACID

## Synonyms:

 $\beta$ -butenoic acid      vinylacetic acidFormula:  $\text{CH}_2:\text{CHCH}_2\text{COOH}$ 

Formula Weight: 86.1

Melting Point:  $-39^\circ\text{C}$ .Boiling Point:  $163^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.013(15/15)

Refractive Index: 1.4257 at  $15^\circ\text{C}$ .

## Solubility:

soluble in water       $\infty$  (in ether)  
 $\infty$  (in alcohol)

## 2-BUTEN-1-OL

## Synonyms:

crotonyl alcohol       $\gamma$ -methylallyl  
crotyl alcohol      alcohol  
propenyl carbinolFormula:  $\text{CH}_3\text{CH}:\text{CHCH}_2\text{OH}$ 

Characteristics: characteristic odor

Formula Weight: 72.1

Melting Point:  $<-30^\circ\text{C}$ .Boiling Point: 117 to  $120^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.8726(0/4)      0.853(20/4)

Refractive Index: 1.4240

## Solubility (grams per 100 ml.):

16.6 (in water)       $\infty$  (in ether)  
 $\infty$  (in alcohol)

## 3-BUTEN-1-OL

## Synonyms:

allylcarbinol      1-buten-4-ol  
allylmethanol      vinylethyl alcoholFormula:  $\text{CH}_2:\text{CHCH}_2\text{CH}_2\text{OH}$ 

Formula Weight: 72.1

Boiling Point:  $113^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.864(0/4)      0.838(17.5/4)

Refractive Index: 1.4146 at  $17.5^\circ\text{C}$ .

## Solubility:

soluble in water      soluble in ether  
 $\infty$  (in alcohol)

## 3-BUTEN-2-OL

## Synonyms:

methylvinylcarbinol  
methylvinylmethanolFormula:  $\text{CH}_2:\text{CHCHOHCH}_3$ 

Formula Weight: 72.1

Melting Point:  $<-80^\circ\text{C}$ .Boiling Point: 96 to  $97^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.831(10/4)

Solubility:  $\infty$  (in water)

## 3-BUTEN-2-ONE

Synonyms: methyl vinyl ketone

Formula:  $\text{CH}_2:\text{CHCOCH}_3$ 

## Characteristics:

toxic      strongly lachry-  
matory

Formula Weight: 70.1

## Boiling Point:

 $81.0$  to  $81.7^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8636(20/4)

Refractive Index: 1.4086

Uses: organic syntheses

Solubility:  $\infty$  (in water)

## Additional Data:

the commercial azeotrope contains  
85% methyl vinyl ketone, 15% H(2)O  
a trace of diacetyl, 0.6% acetic acid  
and 0.1% catechol or hydroquinone  
boiling point of the azeotrope  $75.8^\circ\text{C}$   
the density of the azeotrope  
 $0.8864(20/4)$   
the pure compound tends to polymerize  
causes dermatitis

2-BUTENYL ACETATE

Synonyms:  
2-buten-1-ol                      crotonyl acetate  
acetate                              crotyl acetate  
2-butenyl  
ethanoate

Formula:  
 $\text{CH}_3\text{COOCH}_2\text{CH}:\text{CHCH}_3$

Formula Weight: 114.1

Boiling Point:  
128.5 to 129.5° C. (at 760 mm.)

Specific Gravity: 0.934(0/4)

Solubility:  
slightly soluble                      soluble in alcohol  
in water                                  soluble in ether

2,β-BUTOXYETHOXYETHYL BROMIDE

Formula:  
 $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{Br}$

Formula Weight: 225.1

Boiling Point: 107 to 109° C. (at 12 mm.)

2,β-BUTOXYETHOXYETHYL CHLORIDE

Formula:  
 $\text{C}_4\text{H}_9\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{Cl}$

Formula Weight: 177.5

Boiling Point: 200 to 225° C. (at 760 mm.)

Specific Gravity: 1.00 at 20° C.

Flash Point: 190° F. (closed)

Uses:  
organic syntheses                      solvent  
intermediate

β-BUTOXYETHYL SALICYLATE

Formula:  
 $\text{HOC}_6\text{H}_4\text{COOCH}_2\text{CH}_2\text{OC}_4\text{H}_9$

Formula Weight: 238.3

Melting Point: < -20° C.

Boiling Point: 186 to 193° C. (at 760 mm.)

Specific Gravity: 1.077(25/25)

Solubility:  
insoluble in water                      ∞ (in chloroform)  
∞ (in alcohol)                              ∞ (in benzene)  
∞ (in ether)

N-BUTYL ACETAMIDE

Synonyms: N-mono-butylacetamide

Formula:  $\text{CH}_3\text{CONHC}_4\text{H}_9$

Characteristics: faint odor

Formula Weight: 115.2

Melting Point: -12° C.

Boiling Point: 235 to 140° C. (at 760 mm.)

Specific Gravity: 0.902(20/20)

Refractive Index: 1.441

Surface Tension (dynes per cm.):  
14.3 at 25° C.

Flash Point: 240° F. (closed)

Additional Data: coefficient of expansion,  
0.00097 per ° C.

BUTYL ACETATE

Synonyms:  
acetic acid                              butyl ethanoate  
butyl ester

Formula:  $\text{CH}_3\text{COO}(\text{CH}_2)_3\text{CH}_3$

Characteristics:  
pleasant pineapple odor in low concen-  
tration  
disagreeable odor in higher concen-  
trations  
sour-sweet taste                      pineapple flavor

Formula Weight: 116.2

Melting Point: -76.8 to -76.3° C.

Boiling Point:  
124 to 126.5° C.                      110 to 145° C.  
(at 760 mm.)                              (at 760 mm.)  
125.1° C.                                  119 to 127° C.  
(at 740 mm.)                              (at 760 mm.)  
115 to 135° C.  
(at 760 mm.)

## BUTYL ACETATE (Cont.)

## Specific Gravity:

0.882(20/4)                      0.8826(20/20)

0.9016(0/0)

7.29 lbs. per gal. at 20° C.

Refractive Index: 1.3951

## Viscosity:

absolute viscosity 6.714 millipoises at  
25° C.

10% 1/2 sec. Nitrocellulose Solution

57 centipoises

Inflammability Range (volume per cent  
in air):

1.7 (lower limit)              15 (upper limit)

## Flash Point:

90° F. (open)                      100 to 102° F.  
(open)

72 to 78° F. (closed)

Heat of Vaporization (gram-calories  
per g.): 77.4

## Uses:

solvent for camphor, cellulose nitrate,  
gum rubber, natural and synthetic  
resins, oils, pitchmost important medium boiling solvent  
for nitrocellulose, airplane dopes,  
artificial leather, artificial pearl,  
cellulose products, cements, coated  
papers, lacquers, lacquer thinners,  
leather, linoleum, nail enamel,  
nitrocellulose lacquers, photo-  
graphic films, perfumes, pyroxylin  
plastics, textile sizing and printing  
compounds, safety glass, washable  
wall papercomponent of apricot, banana, butter,  
grenadine, butter-scotch, mirabelle-  
plum, peach, pear, quince, pineapple  
and raspberry flavors

Solubility (grams per 100 ml.):

1.4 (of water)                      ∞ (in alcohol)  
at 20° C.                              ∞ (in ether)2.9 (in water)  
at 25° C.

## Additional Data:

inflammable                      vapor density, 4.1

weight of pure vapor, 5200 mg. per liter

coefficient of expansion,

0.000672 per ° F.    0.00113 per ° C.

critical temperature, 306° C.

dielectric constant, 5.0 at 20° C.

autoignition temperature, 790° F.

## Azeotropic Mixtures

%	%	%	b.p(° C.)
Butyl Acetate	Butanol	H <sub>2</sub> O	
33	67	-	117.6
72	-	28	90.5

Dilution Ratios  
(Nitrocellulose Method)

With toluene . . . . . 2.9

With petroleum naphtha . . . . . 1.4

## Blush Resistance at 90° F.

(10% 1/2 sec. nitrocellulose solution)

	Clear	Blush
Relative humidity . . . .	85%	90%

## Evaporation Rate at 95° F.

%	Minutes
5 . . . . .	1 1/4
25 . . . . .	6 1/2
50 . . . . .	13 1/2
75 . . . . .	22 3/4
90 . . . . .	31
95 . . . . .	34 3/4

sec-BUTYL ACETATE

## Synonyms:

acetic acid	<u><i>d</i></u> -methylpropyl
<u>sec</u> -butyl ester	ethanoate
<u>sec</u> -butyl	<u><i>d</i></u> -methylpropyl
ethanoate	acetate
2-butanol acetate	

Formula: CH<sub>3</sub>COOCH(CH<sub>3</sub>)C<sub>2</sub>H<sub>5</sub>

Characteristics: no residual fruity odor

Formula Weight: 116.2

Melting Point: -98.9° C.

## Boiling Point:

112 to 113° C.	115 to 125° C.
(at 760 mm.)	(at 744 mm.)
105 to 115° C.	105 to 127° C.
(at 760 mm.)	(at 760 mm.)

0.865(25/4)                      0.8711(20/4)  
0.860 to 0.866(20/20)  
7.27 lbs. per gal. at 20° C.

1.3877                      1.3866 at 25° C.

85° F. (open)      76° F. (closed)

Heat of Vaporization (gram-calories per g.): 74.7

solvent for asphalt, benzyl abietate, colophony, cumarone, elemi, ester gum, flavors, kauri, manila, mastic, pontianac, and tar

1.65 (of water)	miscible with
0.62 (in water)	hydrocarbons,
very soluble in	castor and
alcohol	linseed oils
very soluble in	
ether	

vapor density, 4.1  
weight of pure vapor, 5200 mg. per liter  
coefficient of expansion,  
0.000668 per ° F.    0.00118 at 10 to  
                                       30° C.

the water azeotrope contains 77.5% of ester and boils at 87° C.

**Synonyms:** acetic acid tert-butyl ester

Formula:  $\text{CH}_3\text{COOC}(\text{CH}_3)_3$

Formula Weight: 116.2

Boiling Point: 95 to 96° C. (at 760 mm.)

Specific Gravity: 0.896 at 20° C.

Flash Point: 100° F. (open)

**Solubility:** insoluble in water

 $\infty$  (in alcohol)       $\infty$  (in ether)

**Synonyms:** acetoacetic acid butyl ester

**Formula:**  $\text{CH}_3\text{COCH}_2\text{COO}(\text{CH}_2)_3\text{CH}_3$

**Formula Weight: 158.2**

213.9° C.	98 to 100° C.
(at 760 mm.)	(at 16 mm.)

Vapor Pressure (mm. of Hg.):  
0.19 at 20° C.

**Specific Gravity: 0.9694(20/20)**

dyes pharmaceuticals  
organic metal  
derivatives

2.8 (of water)	soluble in alcohol
0.40 (in water)	soluble in ether

**Formula:**  $C_{17}H_{32}(OCOCH_3)COOC_4H_9$

yellow mild odor  
oily

**Formula Weight: 396.5**

cloudy at  $-32^{\circ}\text{C}$ .      solid at  $-65^{\circ}\text{C}$ .

220 to 235° C. ( at 3 to 5 mm.)

**Specific Gravity:**

0.940(20/20)      7.8 lbs. per gal.  
at 68° F.

Refractive Index: 1.4614

**Viscosity (Saybolt): 123 sec. at 100° F.**

Flash Point: 230° F. (closed)

cleaning	detergent
compounds	emulsifier
plasticizer for pro-	lubricant
TECTIVE COATINGS	
QUICK BREAKING	
EMULSIONS	

## BUTYL ACETYLRICINOLEATE (Cont.)

## Solubility:

will dissolve 2% of water by volume  
practically insoluble in water  
miscible with most organic solvents

## Additional Data:

saponification number, 235

## BUTYL ACRYLATE

Synonyms: acrylic acid butyl ester

Formula:  $\text{CH}_2\text{:CHCOOC}_4\text{H}_9$

Formula Weight: 128.2

Boiling Point: 145 to 146°C. (at 760 mm.)

Specific Gravity: 0.898(20/4)

Refractive Index: 1.4185

Solubility: insoluble in water

∞ (in alcohol) ∞ (in ether)

## BUTYL ADIPATE

## Synonyms:

adipic acid butyl ester      dibutyl adipate

Formula:  $(\text{CH}_2\text{CH}_2\text{COOC}_4\text{H}_9)_2$

Formula Weight: 258.4

Melting Point: -37.5°C.

Boiling Point: 183°C. (at 14 mm.)

Specific Gravity: 0.9652(20/4)

Solubility: insoluble in water

∞ (in alcohol) ∞ (in ether)

## BUTYL ALCOHOL

## Synonyms:

1-butanol      propyl methanol  
butyric alcohol

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$

## Characteristics:

highly refractive      non-residual odor  
of fusel oil

Formula Weight: 74.1

Melting Point: -89.8 to -79.9°C.

## Boiling Point:

115 to 118°C.	117.5°C.
(at 760 mm.)	(at 760 mm.)
116 to 119°C.	
(at 760 mm.)	

## Specific Gravity:

0.8098(20/4)	0.8109(20/20)
0.810 to 0.813(20/20)	
6.8 lbs. per gal. at 20°C.	

Refractive Index: 1.3993

## Surface Tension (dynes per cm.):

26.2 at 0°C.	22.1 at 50°C.
24.6 at 20°C.	17.8 at 100°C.

## Viscosity (centipoises):

absolute viscosity 29.48 millipoises  
at 20°C.

5.186 at 0°C.	1.411 at 50°C.
2.948 at 20°C.	0.930 at 70°C.
1.782 at 40°C.	0.540 at 100°C.

## Uses:

solvent for ethyl cellulose, most  
resins, shellac  
latent solvent for nitrocellulose  
used in the manufacture of airplane  
dopes, antiseptics, artificial leather,  
drugs, butyl compounds, coated  
papers, dyes, esters, lacquers, metal  
cleaners, molded goods, ore flota-  
tion compounds, paint and varnish  
removers, patent and enameled  
leather, penetrating oils, perfumes,  
pharmaceuticals, photographic films,  
polishes, printing inks, rust re-  
movers, safety glass, textile product  
dehydrating agent      surface tension  
blending agent      depressant

## Solubility:

will dissolve 20.1% by weight of water  
at 20°C.

9 g. (in water)	∞ (in alcohol)
at 15°C.	∞ (in ether)

7.9 g. (in water)	soluble in many
at 20°C.	organic solvents

8.9 g. (in water)
at 25°C.

Additional Data:

inflammable  
 burns with a very luminous flame  
 vapors irritate and cause coughing  
 azeotrope with water contains 63%  
 butanol and boils at 93° C.  
 coefficient of expansion,  
 0.000517 per ° F. 0.00092 per ° C.  
 critical pressure, 48.4 atm.  
 critical temperature, 287° C.  
 dielectric constant, 16.1 at 25° C.  
 electrical conductivity,  
 9.12 x 10<sup>-9</sup> mhos at 25° C.  
 weight of pure vapor, 3300 mg. per  
 liter  
 vapor density, 2.56  
 autoignition temperature, 693° F.

Evaporation Rate at 95° F.

%	Minutes
5	2 1/2
25	13 1/4
50	26 3/4
75	44 1/2
90	59 1/2
95	67

sec-BUTYL ALCOHOL

Synonyms:

2-butanol                      2-hydroxy-  
 butylene hydrate           butane  
 ethylmethyl-  
 methanol

Formula: C<sub>2</sub>H<sub>5</sub>CHOHCH<sub>3</sub>

Characteristics: vinous odor

Formula Weight: 74.1

Melting Point: -114.7° C.

Boiling Point:

99.5° C. (at 760 mm.)  
 98 to 101° C. (at 760 mm.)  
 96 to 103° C. (at 760 mm.)

Specific Gravity:

0.808(20/4)                      0.8065(20/4)  
 6.73 lbs. per gal. at 20° C.

Refractive Index:

1.3949 at 25° C.                      1.3971 at 20° C.

Flash Point:

85° F. (open)                      76° F. (closed)

Specific Heat (gram-calories per g.  
 per ° C.): 0.67 (liquid)

Heat of Vaporization (gram-calories  
 per g.): 134.4

Uses:

lacquers and lacquer thinners  
 solvent for elemi, ester gum, kauri,  
 mastic, resins, sandarac, shellac,  
 cellulose ester, varnishes  
 manufacture of dyes, esters, fruit  
 essences, perfumes, wetting agents,  
 secondary butyl compounds, dye in-  
 termediates, and organic chemicals

Solubility (grams per 100 ml.):

36.0 (of water) per 100 g. of solution  
 24.4 (in water) per 100 g. of solution  
 12.5 g. (in water) at 20° C.  
 ∞ (in alcohol)                      ∞ (in ether)

Additional Data:

coefficient of expansion,  
 0.000545 per ° F.,  
 0.00091 at 10 to 30° C.  
 weight of pure vapor, 3300 mg. per  
 liter  
 vapor density, 2.56  
 critical temperature, 265° C.  
 critical pressure, 48 atm.  
 azeotrope with water contains 72.7%  
 by weight of alcohol and boils at  
 87.5° C.

Evaporation Rate at 95° F.

%	Minutes
5	1 1/2
25	6 1/2
50	13 1/4
75	21 1/2
90	28 3/4
95	32 1/4

tert-BUTYL ALCOHOL

Synonyms:

2-methyl-2-                      trimethyl  
 propanol                      methanol  
 pseudobutyl alcohol

Formula: (CH<sub>3</sub>)<sub>3</sub>COH

## tert-BUTYL ALCOHOL (Cont.)

## Characteristics:

slight camphorlike odor

Formula Weight: 74.1

## Melting Point:

25.0 to 25.6° C.      25.3° C.

## Boiling Point:

82.4 to 82.9° C.      78 to 85° C.  
(at 760 mm.)      (at 760 mm.)81.5 to 83° C.  
(at 760 mm.)

## Specific Gravity:

0.7791(26/4)      0.7887(20/4)  
0.780 to 0.786(25/25)  
6.51 lbs. per gal. at 26° C.

## Surface Tension (dynes per cm.):

20.7 at 20° C.

## Flash Point:

60° F. (open)      48 to 52° F.  
(closed)Specific Heat (gram-calories per g.  
per ° C.):

0.726 (liquid) at 27° C.

Heat of Vaporization (gram-calories  
per g.): 130.6Heat of Fusion (gram-calories per g.):  
21.0Heat of Combustion (kilogram-calories  
per g.-mol): 629.3 (liquid)

## Uses:

mutual solvent and blending agent  
disinfectants      organic syntheses  
insecticides      lacquers  
fumigants      dye intermediates  
alcohol denaturant      plastics  
cellulose ethers

## Solubility:

∞ (of water)      ∞ (in alcohol)  
∞ (in water)      ∞ (in ether)  
miscible with most organic solvents

## Additional Data:

coefficient of expansion,  
0.000740 per ° F.weight of pure vapor, 3300 mg. per  
liter

vapor density, 2.56

azeotrope with water contains 88.3%  
by weight of alcohol and boils at  
79.9° C.

autoignition temperature, 901° F.

critical temperature, 235° C.

critical pressure, 49 atm.

## BUTYLAMINE

## Synonyms:

1-aminobutane      n-monobutylamine

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ 

Characteristics: ammoniacal odor

Formula Weight: 73.1

Melting Point: -50.5 to -50° C.

## Boiling Point:

77.1° C.      73 to 86° C.  
(at 760 mm.)      (at 760 mm.)

## Specific Gravity:

0.7385(20/20)      0.739(25/4)  
0.7401(20/4)      0.742 at 15° C.  
6.2 lbs. per gal. at 20° C.

Refractive Index: 1.401

Surface Tension (dynes per cm.):  
19.7 at 41° C.

## Viscosity (centipoises):

0.68 at 25° C.      0.36 at 60° C.

Flash Point: &lt;40° F. (open)

Heat of Combustion (kilogram-calories  
per mol): 710.6 (liquid)

## Uses:

corrosion      insecticides  
inhibitors      rubber chemicals  
dyes      specialty soap  
emulsifying agents      textile desizing  
flotation agents      agent

## Solubility:

$\infty$  (in water) very soluble in  
 very soluble in ether  
 alcohol  
 soluble in acetone, benzene, gasoline,  
 methyl alcohol, and ethyl acetate

## Additional Data:

coefficient of expansion,  
 0.00134 per °C.  
 optically inactive

pH of Aqueous Solution at 25°C.

pH	Normality
1.0	<u>12.45</u>
0.5	<u>12.28</u>
0.1	<u>11.86</u>
0.05	<u>11.71</u>
0.01	<u>11.20</u>
0.001	<u>10.42</u>

sec-BUTYLAMINE

## Synonyms:

(d-methylpropyl) mono-sec-butyl-  
 amine amine

Formula:  $\text{CH}_3\text{CH}(\text{NH}_2)\text{C}_2\text{H}_5$

Characteristics: ammoniacal odor

Formula Weight: 73.1

Melting Point: -104°C.

## Boiling Point:

63°C. 62 to 69°C.  
 (at 760 mm.) (at 760 mm.)  
 66°C.  
 (at 772 mm.)

## Specific Gravity:

0.718 to 0.725(20/20)  
 0.724(20/4)

## Refractive Index:

1.394 1.3950 at 16.7°C.

Viscosity (centipoises): 0.44 at 20°C.

Flash Point: <20°F. (closed)

Heat of Combustion (kilogram-calories  
 per g.-mol): 713.0 (liquid)

## Solubility:

$\infty$  (in water)  $\infty$  (in ether)  
 $\infty$  (in alcohol)  
 soluble in acetone, benzene, gasoline,  
 methyl alcohol, and ethyl acetate

Additional Data: coefficient of expansion,  
 0.00184 per °C.

tert-BUTYLAMINE

## Synonyms:

2-aminoisobutane  
 (d,d-dimethylethyl) amine  
 trimethylaminomethane  
 trimethylcarbinylamine

Formula:  $(\text{CH}_3)_3\text{CNH}_2$

Formula Weight: 73.1

Melting Point: -67.5°C.

## Boiling Point:

44.0 to 46.4°C. (at 760 mm.)

## Specific Gravity:

0.698(18/4) 0.700 at 15°C.  
 0.696(20/4)

Refractive Index: 1.3794 at 18°C.

Heat of Combustion (kilogram-calories  
 per g.-mol): 716.0

## Solubility:

$\infty$  (in water)  $\infty$  (in ether)  
 $\infty$  (in alcohol)

## BUTYLANILINE

Synonyms: N-mono-n-butylaniline

## Formula:

$\text{C}_6\text{H}_5\text{NHCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

## Characteristics:

amber color aniline odor

Formula Weight: 149.2

Melting Point: -14°C.

## Boiling Point:

240.9°C. 234 to 242°C.  
 (at 760 mm.) (at 760 mm.)  
 255°C.  
 (at 720 mm.)

## BUTYLANILINE (Cont.)

Specific Gravity: 0.925(20/20)

Refractive Index: 1.534

Viscosity (centipoises): 3.01

Flash Point: 225° F. (closed)

## Solubility:

insoluble in water      very soluble in

very soluble in      ether

alcohol

soluble in acetone, benzene, gasoline,

ethyl alcohol, and ethyl acetate

Additional Data: coefficient of expansion,  
0.00091 per °C.

## BUTYLBENZENE

Synonyms: 1-phenylbutane

Formula:  $C_6H_{11}(CH_2)_3CH_3$ 

Formula Weight: 134.2

Melting Point:

-81.2° C.

-88.5° C.

Boiling Point:

180 to 183.1° C. (at 760 mm.)

Specific Gravity: 0.862(20/4)

Refractive Index:

1.4880

1.494 at 13° C.

Specific Heat (Btu. per lbs. per °F.):

0.428 at 77° F.

Heat of Fusion (gram-calories per g.):

19.5 at 15° C.

Uses: organic syntheses

## Solubility:

insoluble in water      very soluble in

very soluble in      ether

alcohol

## Additional Data:

coefficient of expansion,

0.00053 at 32 to 86° F.

aniline point &lt; -22

total heating values at 77° F. 18790

Btu. per lb., 134900 Btu. per cu. ft.

for the gas

API gravity, 31.4 at 60° F.

specific gravity of gas (ideal)

(air = 1.0), 4.6334

specific gravity of the liquid (in vacuo)

0.86415(20/4)° C. 0.8687(60/60)° F.

liquid density (in vacuo), 7.242 at 60°

## sec-BUTYLBENZENE

Synonyms: 2-phenylbutane

Formula:  $C_6H_5CH(CH_3)C_2H_5$ 

Formula Weight: 134.2

Melting Point: -82.7° C.

Boiling Point:

173 to 174° C.

172.5° C.

(at 760 mm.)

(at 760 mm.)

Specific Gravity:

0.861(20/4)

0.8634(20/4)

7.21 lbs. per gal. at 20° C.

Refractive Index:

1.4900

1.4894 at 21° C.

Flash Point: 126° F. (closed)

## Uses:

narrow boiling point aromatic solvent

organic syntheses of dyes, fine chem-

icals, and surface active agents

## Solubility:

insoluble in water

very soluble in

very soluble in

ether

alcohol

## Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 4.6334

API gravity, 31.8 at 60° F.

aniline point, &lt; -20° F.

vapor density, 4.62

bromine number, 0.5

specific gravity of liquid (in vacuo),

0.8618(20/4)° C. 0.8663(60/60)° F.

liquid density (in vacuo),

7.223 at 60° F.

tert-BUTYLBENZENE

Synonyms:

2-methyl-2-phenylpropane  
trimethylphenylmethane

Formula:  $C_6H_5C(CH_3)_3$

Formula Weight: 134.2

Melting Point:  $-58.1^{\circ}C$ .

Boiling Point: 168 to  $169^{\circ}C$ . (at 760 mm.)

Specific Gravity: 0.867(20/4)

Refractive Index: 1.4960

Specific Heat (Btu. per lb. per  $^{\circ}F$ .):  
0.424 (liquid) at  $70.3^{\circ}F$ .

Heat of Fusion (gram-calories per g.):  
14.9 at  $15^{\circ}C$ .

Heat of Combustion (kilogram-calories  
per mole): 1400.4 (liquid)

Solubility:

insoluble in water      very soluble in  
very soluble in      ether  
alcohol

Additional Data:

specific gravity of gas (ideal)  
(air = 1.0), 4.6334  
liquid density (in vacuo), 7.262  
API gravity, 31.0 at  $60^{\circ}F$ .  
specific gravity of liquid (in vacuo),  
 $0.8665(20/4)^{\circ}C$ .     $0.8710(60/60)^{\circ}F$ .  
total heating values (at  $77^{\circ}F$ .) 18770  
Btu. per lb., 135100 Btu. per cu. ft.  
of the gas

BUTYL BENZOATE

Synonyms:

benzoic acid butyl ester  
butyl benzenecarboxylate

Formula:  $C_6H_5COO(CH_2)_3CH_3$

Characteristics: oily

Formula Weight: 178.2

Melting Point:  $-22.4^{\circ}C$ .

Boiling Point:

248.5 to  $250.3^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.000(20/4)      1.005(25/25)

Solubility:

insoluble in water      very soluble in  
very soluble in      ether  
alcohol

BUTYL BUTYRATE

Synonyms:

butyl butanoate      butyric acid butyl  
ester

Formula:  $CH_3(CH_2)_2COO(CH_2)_3CH_3$

Characteristics:

agreeably fruity odor  
resembles pineapple flavor on dilution

Formula Weight: 144.2

Melting Point:  $-91.5^{\circ}C$ .

Boiling Point:

$166.4^{\circ}C$ .       $152$  to  $170^{\circ}C$ .  
(at 760 mm.)      (at 760 mm.)  
 $165.7^{\circ}C$ .  
(at 736 mm.)

Vapor Pressure (mm. of Hg.): 4 at  $30^{\circ}C$ .

Specific Gravity: 0.8721(20/20)

Refractive Index: 1.4049

Flash Point:  $128^{\circ}F$ . (closed)

Uses:

apricot      pear  
butter      pineapple  
butterscotch      woodruff essences

Solubility (per cent by weight):

0.43 (of water)       $\infty$  (in alcohol)  
0.05 (in water)       $\infty$  (in ether)

Additional Data: coefficient of expansion,  
0.00107 at 10 to  $30^{\circ}C$ .

BUTYL CAPROATE

Synonyms:

butyl hexanoate      caproic acid butyl  
ester

Formula:

$CH_3(CH_2)_4COO(CH_2)_3CH_3$

## BUTYL CAPROATE (Cont.)

## Characteristics:

fruity odor                      winey aroma

Formula Weight: 172.3

Boiling Point: 204.3° C. (at 760 mm.)

Specific Gravity: 0.882 to 0.8843(0/0)

Uses: apple and pear flavors

## Solubility:

insoluble in                      ∞ (in alcohol)  
water                              ∞ (in ether)

## BUTYL CAPRYLATE

Synonyms: caprylic acid butyl ester

Formula:  $C_7H_{15}COOC_4H_9$

Formula Weight: 200.3

Boiling Point: 240.5° C. (at 760 mm.)

Specific Gravity: 0.880(0/0)

## BUTYL "CARBITOL"

## Synonyms:

diethylene glycol monobutyl ether

## Formula:

$C_4H_9OCH_2CH_2OCH_2CH_2OH$

Characteristics: nearly odorless

Formula Weight: 162.2

## Boiling Point:

230.4° C. (at 760 mm.)  
231.2° C. (at 760 mm.)  
220 to 231° C. (at 760 mm.)

Specific Gravity: 0.9536(20/20)

8.0 lbs. per gal. at 20° C.

Refractive Index: 1.4920 at 27° C.

Surface Tension (dynes per cm.):

33.6 at 25° C.

Viscosity (poises): 0.025 at 20° C.

## Flash Point:

200° F. (open)                      172° F. (closed)

Specific Heat (gram-calories per g.

per ° C.): 0.546 at 20 to 25° C.

Heat of Vaporization (gram-calories per g.):

61.9 at the boiling point

## Uses:

solvent for dyes, dopes, gums, lacquers, nitrocellulose, plastics, printing inks, resins, soap mutual solvent for soaps, oils and waxes

## Solubility:

∞ (in water)                      ∞ (mineral oils)  
∞ (in alcohol)

## Additional Data:

coefficient of expansion,  
0.00087 at 10 to 30° C.  
autoignition temperature, 442° F.  
vapor density, 5.58

## BUTYL "CARBITOL" ACETATE

## Synonyms:

β-butoxy-β-ethoxyethyl acetate  
diethylene glycol monobutyl ether acetate

## Formula:

$CH_3COOCH_2CH_2OCH_2CH_2OC_4H_9$

Characteristics: nearly odorless

Formula Weight: 204.3

## Boiling Point:

246.4° C. (at 760 mm.)  
236 to 249° C. (at 760 mm.)

## Vapor Pressure:

0.04 at 20° C.                      <0.1 at 30° C.

Specific Gravity: 0.9810(20/20)

8.16 lbs. per gal. at 20° C.

Flash Point: 240° F. (open)

## Uses:

solvent for cellulose nitrate, coatings, gums, lacquers, oils, resins, synthetic resin coatings

Solubility (per cent by weight):

3.7 (of water)                      6.5 (in water)  
at 20° C.                              at 20° C.

Additional Data: coefficient of expansion,  
0.00094 at 10 to 30° C.

## BUTYL CARBONATE

## Synonyms:

carbonic acid dibutyl carbonate  
butyl ester

Formula:  $\text{CO}[\text{O}(\text{CH}_2)_3\text{CH}_3]_2$

Formula Weight: 174.2

Boiling Point: 207°C. (at 760 mm.)

Specific Gravity: 0.924 at 20°C.

## Solubility:

insoluble in water soluble in alcohol

sec-BUTYL CARBONATE

## Synonyms:

carbonic acid sec- di-sec-butyl  
butyl ester carbonate

Formula:  $\text{CO}[\text{OC}(\text{CH}_3)_3]_2$

Formula Weight: 174.2

Boiling Point: 178 to 180°C. (at 760 mm.)

## BUTYL "CELLOSOLVE"

## Synonyms:

2-butoxy-1-ethanol  
ethylene glycol monobutyl ether

Formula:  $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OH}$

Formula Weight: 118.2

## Boiling Point:

171.2°C. 166 to 173°C.  
(at 760 mm.) (at 760 mm.)

## Vapor Pressure (mm. of Hg):

0.6 at 20°C. 2 at 30°C.

## Specific Gravity:

0.9019(20/20) 0.903(20/4)  
0.9188(15/15)  
7.5 lbs. per gal. at 20°C.

Refractive Index: 1.4190 at 20°C.

Surface Tension (dynes per cm.):

31.5 at 25°C.

Viscosity (centipoises): 3.318 at 25°C.

## Flash Point:

1650 F. (open) 1410 F. (closed)

Specific Heat (gram-calories per g.  
per °C.): 0.583 (liquid)

## Uses:

lacquer solvent dry cleaning  
solvent for albumins, brushing  
lacquers, dry cleaning compounds,  
enamels, grease, nitrocellulose,  
oils, resins, spray lacquers, textile  
cleaning, varnishes and varnish  
removers  
mutual solvent for "soluble" mineral  
oils

## Solubility:

∞ (of water) ∞ (in alcohol)  
∞ (in water) ∞ (in oils)  
soluble in most organic solvents and  
mineral oils

## Additional Data:

coefficient of expansion, 0.00087 at  
10 to 30°C.  
autoignition temperature, 472°F.  
vapor density, 4.07

## Viscosity of Nitrocellulose Solutions

% wt. RS 1/2 sec.  
nitrocellulose..... 5 10 15 20  
Centipoises  
at 20°C..... 44.1 284 1290 5300

## BUTYL "CELLOSOLVE" ACETATE

Formula:  $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OOCCH}_3$

Formula Weight: 160.1

Boiling Point: 188 to 192°C. (at 760 mm.)

Vapor Pressure (mm. of Hg):  
<1 at 30°C.

Specific Gravity: 0.943 at 20°C.  
7.85 lbs. per gal. at 20°C.

Flash Point: 180°F. (open)

Additional Data: coefficient of expansion,  
0.00104 at 10 to 30°C.

## BUTYL "CELLOSOLVE" PHTHALATE

## Synonyms:

butoxy glycol phthalate  
dibutoxy ethyl phthalate  
dibutyl "Cellosolve" phthalate  
"Kronisol"

Formula:  $C_6H_4(COOC_2H_4OC_4H_9)_2$

## Characteristics:

mild characteristic odor

Formula Weight: 366

Melting Point:  $-50^{\circ}C$ . (very viscous)

## Boiling Point:

$\frac{212 \text{ to } 233^{\circ}C.}{(\text{at } 4 \text{ mm.})} \quad \frac{355^{\circ}C.}{(\text{at } 760 \text{ mm.})}$

Specific Gravity: 1.063 at  $20^{\circ}C$ .

8.86 lbs. per gal. at  $20^{\circ}C$ .

Refractive Index: 1.482 at  $25^{\circ}C$ .

Surface Tension (dynes per cm.):

32.4 at  $20^{\circ}C$ .

Flash Point: 396^{\circ}F. (closed)

## Uses:

solvent for ethyl cellulose, copal ester,  
nitrocellulose, Parlon, Vinsol  
does not dissolve cellulose acetate  
damar is only partly soluble in it  
plasticizer for Vinylite and nitro-  
cellulose

## Solubility (per cent):

0.8 (of water) at  $25^{\circ}C$ .      0.1 (in water) at  $25^{\circ}C$ .

soluble in alcohol, ether, chloroform,  
carbon tetrachloride, benzene,  
alcohols, naphtha, toluene, xylene,  
tetralin, chlorinated hydrocarbon  
solvents, isopropanol, turpentine,  
Carbitol, and Cellosolve

## Additional Data:

evaporation rate, 0.001 gram loss per  
sq. cm. after 100 hours at  $100^{\circ}C$ .

volatility, 0.4% after 100 hours at  
 $100^{\circ}C$ .

fire point,  $455^{\circ}F$ .

hydrolysis, 0.04% after refluxing two  
hours with water

resistant to ultraviolet light

## BUTYL "CELLOSOLVE" STEARATE

## Synonyms:

butoxy ethyl stearate  
butyl "Cellosolve" stearate  
KP-23

## Formula:

$CH_3(CH_2)_{16}COOC_2H_4OC_4H_9$

Characteristics: mild odor

Formula Weight: 384

Melting Point: 10 to  $16^{\circ}C$ .

Boiling Point: 215 to  $245^{\circ}C$ . (at 4 mm.)

Specific Gravity: 0.882(20/20)

7.38 lbs. per gal. at  $20^{\circ}C$ .

Refractive Index: 1.446 at  $25^{\circ}C$ .

Flash Point: 380^{\circ}F. (closed)

## Uses:

solvent for copal ester, damar, ethyl  
cellulose, Parlon, and Vinsol  
does not dissolve cellulose acetate  
nitrocellulose and polyvinyl resins are  
insoluble but are compatible in com-  
bination with other plasticizers and  
solvents  
softening agent for rubber  
plasticizer for chlorinated rubber and  
like resins

Solubility (per cent): 1 (of water) at  $20^{\circ}C$

insoluble in water      soluble in mineral  
soluble in gasoline      oil  
insoluble or limited solubility in  
glycerol, glycols, and certain amines  
soluble in most other organic liquids

## Additional Data:

fire point,  $451^{\circ}F$ .

volatility at  $105^{\circ}C$ . 0.5% after 24  
hours, 10.2% after 100 hours

evaporation rate at  $105^{\circ}C$ ., 0.8 mg.  
loss per sq. cm. after 24 hours, 16.3  
mg. loss per sq. cm. after 100 hours

hydrolysis, none after refluxing 2  
hours with water

## BUTYL CHLOROACETATE

## Synonyms:

butyl 2-chloroethanoate  
chloroacetic acid butyl ester

Formula:  $\text{CH}_2\text{ClCOO}(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 150.6

## Boiling Point:

175° C. 181 to 183° C.  
(at 760 mm.)

## Specific Gravity:

1.103(0/4) 1.081 at 15° C.

## BUTYL CHLOROFORMATE

## Synonyms:

butyl 2-chlorocarbonate  
chloroformic acid butyl ester

Formula:  $\text{ClCOO}(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 136.6

Boiling Point: 140 to 145° C. (at 760 mm.)

Specific Gravity: 1.074(25/4)

## Solubility:

decomposes in  $\infty$  (in ether)  
water  
decomposes in  
alcohol

p-tert-BUTYL-o-CRESOL

## Synonyms:

2-methyl-4-tert-butylphenol

Formula:  $(\text{CH}_3)_3\text{CC}_6\text{H}_3(\text{CH}_3)\text{OH}$

Formula Weight: 164.2

Melting Point: 27° C.

Boiling Point: 137 to 138° C. (at 25 mm.)

Specific Gravity: 0.969(30/25)

## Solubility: insoluble in water

$\infty$  (in methyl  $\infty$  (in carbon  
alcohol) tetrachloride)  
 $\infty$  (in chloroform)  $\infty$  (in benzene)

## BUTYL CROTONATE

## Synonyms: crotonic acid butyl ester

Formula:  $\text{CH}_3\text{CH}:\text{CHCOOC}_4\text{H}_9$

## Characteristics:

colorless to light pleasant persist-  
yellow ent odor

Formula Weight: 142.2

Boiling Point: 175 to 180° C. (at 760 mm.)

Specific Gravity: 0.9037(20/20)

7.52 lbs. per gal. at 20° C.

## Uses:

solvent for softening agents  
coated papers and lacquers  
modifying agent for some resins

## Solubility: insoluble in water

soluble in alcohol soluble in ether

BUTYL d,d-DIBROMOSUCCINATE

## Synonyms:

d,d-dibromosuccinic acid butyl ester

Formula:  $(\text{CHBrCOOC}_4\text{H}_9)_2$

Formula Weight: 388.1

Boiling Point: 171 to 174° C. (at 8 mm.)

## BUTYLDIETHANOLAMINE

Formula:  $\text{C}_4\text{H}_9\text{N}(\text{CH}_2\text{CH}_2\text{OH})_2$

## Characteristics:

faint amine odor colorless to light  
straw color

Formula Weight: 161.2

Melting Point: -70° C.

## Boiling Point:

237 to 250° C. 262 to 290° C.  
(at 741 mm.) (at 760 mm.)

Specific Gravity: 0.968(20/4)

7.25 lbs. per gal.

Refractive Index: 1.462 at 20° C.

## Viscosity (centipoises):

55 at 25° C. 10.6 at 60° C.

## BUTYLDIETHANOLAMINE (Cont.)

Flash Point: 245° F. (closed)

## Solubility:

∞ (in water)	∞ (in gasoline)
∞ (in alcohol)	soluble in acetone
∞ (in ether)	soluble in ethyl
∞ (in benzene)	acetate

Additional Data: coefficient of expansion,  
0.00077 per °C.

## BUTYL DISULFIDE

## Synonyms:

1-butyldithio-	dibutyl sulfide
butane	
dibutyl disulfide	

Formula:  $(C_4H_9)_2S_2$ 

Formula Weight: 178.4

## Boiling Point:

117 to 118° C.	100 to 103° C.
(at 20 mm.)	(at 15 mm.)

## Solubility: insoluble in water

∞ (in alcohol)	∞ (in ether)
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## BUTYLETHANOLAMINE

Synonyms: butyl monoethanolamine

Formula:  $C_4H_9NHC_2H_4OH$ 

Characteristics: very faint amine odor

Formula Weight: 117.2

Melting Point: -3.5° C.Boiling Point: 192 to 215° C. (at 760 mm.)Specific Gravity: 0.89(20/20)7.44 lbs. per gal.Refractive Index: 1.444

## Viscosity (centipoises):

<u>17.4</u> at 25° C.	<u>4.02</u> at 60° C.
-----------------------	-----------------------

Flash Point: 170° F. (closed)

## Solubility:

soluble in water, methyl alcohol, ether,  
acetone, benzene, gasoline, and ethyl  
acetateAdditional Data: coefficient of expansion,  
0.0010 per °C.

pH of Aqueous Solution at 25° C.

Normality	pH	Normality	pH
0.1 . . .	<u>11.39</u>	0.01 . . .	<u>10.85</u>
0.05 . . .	<u>11.27</u>	0.001 . . .	<u>10.21</u>

## BUTYL ETHER

## Synonyms:

1-butoxybutane      dibutyl ether

Formula:  $(CH_3CH_2CH_2CH_2)_2O$ 

Characteristics: mild ethereal odor

Formula Weight: 130.2

Melting Point: -98 to -95.2° C.

## Boiling Point:

142.4° C. (at 760 mm.)
137 to 143° C. (at 760 mm.)
<u>127 to 142° C.</u> (at 760 mm.)
<u>140.9° C.</u> (at 760 mm.)

Vapor Pressure (mm. Hg): 4.8 at 20° C.

## Specific Gravity:

0.7694(20/20)	0.7841(0/4)
<u>6.4</u> lbs. per gal. at 20° C.	

Refractive Index: 1.3992

Surface Tension (dynes per cm.):

22.9 at 20° C.

## Flash Point:

87 to 100° F. (open) 77° F. (closed)Heat of Vaporization (gram-calories  
per g.): 67.8 at 140.9° C.

## Uses:

organic syntheses      extractant and  
extracting agent      precipitant  
solvent purifica-  
tion  
solvent for esters, gums, hydro-  
carbons, alkaloids, oils, organic  
acids, resins

**Solubility:**

0.19% by weight (of water) at 20° C.  
 0.05 g. per 100 ml. (in water)  
 ∞ (in alcohol) ∞ (in ether)  
 soluble in acetone, benzene, and gasoline  
 miscible with common organic solvents  
 soluble in methanol and ethyl acetate

**Additional Data:**

forms numerous constant boiling mixtures  
 vapor density, 4.48

**sec-BUTYL ETHER****Synonyms:**

di-sec-butyl ether  
 2(a-methylpropoxy) butane

Formula:  $[\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)]_2\text{O}$

Formula Weight: 130.2

Boiling Point: 121° C. (at 760 mm.)

Specific Gravity: 0.756(21/4)

Solubility: slightly soluble in water  
 ∞ (in alcohol) ∞ (in ether)

**BUTYL ETHYL ETHER****Synonyms:**

1-ethoxybutane ethyl butyl ether

Formula:  $\text{C}_2\text{H}_5\text{O}(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 102.2

Melting Point: -124° C.

**Boiling Point:**

90 to 93° C. 91.4° C.  
 (at 760 mm.) (at 760 mm.)

**Specific Gravity:**

0.752(20/4) 0.752(20/20)

Solubility: insoluble in water

∞ (in alcohol) ∞ (in ether)

**tert-BUTYL ETHYL ETHER****Synonyms:**

2-ethoxy-2-methylpropane  
 ethyl tert-butyl ether

Formula:  $\text{C}_2\text{H}_5\text{OC}(\text{CH}_3)_3$

Formula Weight: 102.2

**Boiling Point:**

68 to 69° C. 70° C.  
 (at 760 mm.) (at 758 mm.)

Specific Gravity: 0.7519(20/4)

**Solubility:**

insoluble in water very soluble in  
 very soluble in ether  
 alcohol

**BUTYL FORMATE****Synonyms:**

butyl methanoate formic acid butyl ester

Formula:  $\text{HCOO}(\text{CH}_2)_3\text{CH}_3$

**Characteristics:**

plum aroma odor on dilution  
 sweet taste resembles plums

Formula Weight: 102.1

Melting Point: -90.0° C.

**Boiling Point:**

106.0 to 106.8° C. 96 to 100° C.  
 (at 760 mm.) (at 760 mm.)

**Specific Gravity:**

0.9108(0/4) 0.885 to 0.9108  
 0.8848(25/4)

Refractive Index: 1.3891

Flash Point: 64° F. (closed)

Heat of Vaporization (gram-calories per g.): 86.8 at 15° C.

**Uses:**

organic syntheses  
 solvent for cellulose acetate and ethers, lacquers, nitrocellulose, perfumes, resins  
 greengage, mirabelle-plum, and plum flavors

**Solubility:**

slightly soluble in ∞ (in alcohol)  
 water ∞ (in ether)  
 miscible with alcohols, ethers, oils, and hydrocarbons

Additional Data: vapor density, 3.52

sec-BUTYL FORMATE

## Synonyms:

sec-butyl                      formic acid sec-  
methanoate                      butyl ester

Formula:  $\text{HCOOCH}(\text{CH}_3)\text{C}_2\text{H}_5$ 

Formula Weight: 102.1

## Boiling Point:

97° C.                      93.6° C.  
(at 760 mm.)              (at 760 mm.)

Specific Gravity: 0.882(20/4)

Solubility: slightly soluble in water

∞ (in alcohol)              ∞ (in ether)

## BUTYL FUROATE

Synonyms: furoic acid butyl ester

Formula:  $\text{C}_4\text{H}_3\text{OCOO}(\text{CH}_2)_3\text{CH}_3$ 

Characteristics: oily

Formula Weight: 168.2

## Boiling Point:

83 to 84° C.                      118 to 120° C.  
(at 1 mm.)                      (at 25 mm.)

Specific Gravity: 1.056(20/4)

## Uses:

lacquer solvent              plasticizer

Solubility: insoluble in water

∞ (in alcohol)              ∞ (in ether)

Additional Data: decomposes on standing

sec-BUTYL FUROATESynonyms: furoic acid sec-butyl ester

## Formula:

 $\text{C}_4\text{H}_3\text{OCOOCH}(\text{CH}_3)\text{C}_2\text{H}_5$ 

Formula Weight: 168.2

Boiling Point: 67 to 69° C. (at 1 mm.)

Specific Gravity: 1.0465

Solubility: insoluble in water

∞ (in alcohol)              ∞ (in ether)

BUTYL β-FURYLACRYLATE

## Formula:

 $\text{C}_4\text{H}_3\text{OCH:CHCOO}(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 194.2

Boiling Point: 121° C. (at 5 mm.)

Specific Gravity: 1.048(20/4)

## Solubility:

insoluble in water      soluble in alcohol

BUTYL α-HYDROXYISOBUTYRATE

## Formula:

 $(\text{CH}_3)_2\text{C}(\text{OH})\text{COO}(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 160.2

Boiling Point: 64 to 65° C. (at 760 mm.)

Solubility: insoluble in water

∞ (in alcohol)              ∞ (in ether)

## Additional Data:

turns brown on exposure to light

## BUTYL ISOCYANIDE

Synonyms: butyl carbylamine

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{NC}$ 

Formula Weight: 83.1

Boiling Point: 118° C. (at 760 mm.)

Solubility: insoluble in water

∞ (in alcohol)              ∞ (in ether)

tert-BUTYL ISOCYANIDE

## Synonyms:

(α, α-dimethylethyl) carbylamine

Formula:  $(\text{CH}_3)_3\text{CNC}$ 

Characteristics: oily

Formula Weight: 83.1

Boiling Point: 91° C. (at 37.5 mm.)

Solubility: soluble in alcohol

## BUTYL ISOTHIOCYANATE

## Synonyms:

butyl mustard oil      isothiocyanic acid  
butyl ester

Formula:  $C_2H_5CH_2CH_2NCS$

Characteristics: unpleasant

Formula Weight: 115.2

Melting Point:  $<-65^{\circ}C$ .

165 $^{\circ}C$ . (at 724 mm.)

167 $^{\circ}C$ . (at 760 mm.)

172 to 175 $^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

0.956 at 11.2 $^{\circ}C$ .      0.952(20/20)

0.946(20/4)

Refractive Index: 1.500

Viscosity (centipoises): 0.99 at 25 $^{\circ}C$ .

Flash Point: 150 $^{\circ}F$ . (closed)

Solubility: insoluble in water  
soluble in alcohol      soluble in ether

Additional Data: coefficient of expansion,  
0.00094 per  $^{\circ}C$ .

sec-BUTYL ISOTHIOCYANATE

## Synonyms:

sec-butyl mustard oil  
d-methylpropyl isothiocyanate

Formula:  $C_2H_5CH(CH_3)NCS$

Formula Weight: 115.2

Boiling Point: 159 to 163 $^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

0.943(20/4)      0.944(12/4)

## Specific Rotation:

$[\alpha] = +61.88^{20}_D$

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

tert-BUTYL ISOTHIOCYANATE

## Synonyms:

tert-butyl mustard oil  
d,d-dimethylethyl isothiocyanate

Formula:  $(CH_3)_3CNCS$

Characteristics: pleasant aromatic odor

Formula Weight: 115.2

Melting Point: 10.5 $^{\circ}C$ .

Boiling Point: 140 $^{\circ}C$ . (at 770 mm.)

Specific Gravity: 0.918 at 10 $^{\circ}C$ .

Solubility: insoluble in water  
soluble in alcohol      soluble in ether

## BUTYL ISOVALERATE

## Synonyms: isovaleric acid butyl ester

## Formula:

$(CH_3)_2CHCH_2COO(CH_2)_3CH_3$

## Characteristics:

agreeable fruity odor which on dilution  
resembles apple and pear  
sweet taste      apple flavor

Formula Weight: 158.2

## Boiling Point:

137 to 171 $^{\circ}C$ .      165 $^{\circ}C$ .  
(at 760 mm.)      (at 760 mm.)

Specific Gravity: 0.877

## Uses:

apple, date, grenadine, honey, melon,  
quince, and pear flavors

## Solubility:

insoluble in water      soluble in alcohol

sec-BUTYL ISOVALERATE

## Synonyms:

isovaleric acid sec-butyl ester

## Formula:

$(CH_3)_2CHCH_3COOCH(CH_3)C_2H_5$

## sec-BUTYL ISOVALERATE (Cont.)

Formula Weight: 158.2

Boiling Point: 163 to 164°C. (at 752 mm.)

Specific Gravity: 0.848(20/4)

Solubility: insoluble in water  
∞ (in alcohol) ∞ (in ether)

## BUTYL LACTATE

Synonyms: lactic acid butyl ester

Formula:



Characteristics:

mild odor non-                      brownish  
residual

Formula Weight: 146.2

Boiling Point:

75 to 76°C. (at 6 mm.)

160 to 190°C. (at 188 mm.)

140 to 200°C. (at 760 mm.)

Vapor Pressure (mm. Hg):

0.4 at 20°C.

5 at 30°C.

Specific Gravity:

0.968

0.974 to

0.984(20/20)

8.15 lbs. per gal. at 68°F.

Refractive Index: 1.4216

Flash Point:

178°F. (open)

160°F. (closed)

Heat of Vaporization (gram-calories  
per g.): 77.4 at 20°C.

Uses:

solvent for dyes, ethyl cellulose gums,  
oils, and resinsused for lacquers, inks, varnishes,  
stencil papers, anti-skinning agent,  
and dry cleaners

Solubility (per cent by volume):

13.0 (of water) at 25°C.

3.4 (in water) at 25°C.

∞ (in alcohol)

∞ (in ether)

miscible with most organic solvents,  
diluent and oils

Additional Data:

coefficient of expansion,

0.00099 at 10 to 30°C.

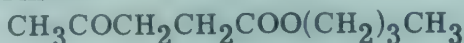
vapor density, 5.04

nonhygroscopic

## BUTYL LEVULINATE

Synonyms: levulinic acid butyl ester

Formula:



Formula Weight: 172.2

Boiling Point: 237 to 238°C. (at 760 mm.)

Specific Gravity: 0.974(20/4)

## BUTYL MALATE

Synonyms:

dibutyl malate

malic acid dibutyl  
ester

Formula:



Formula Weight: 246.3

Boiling Point: 170 to 171°C. (at 13 mm.)

Specific Gravity: 1.038(20/4)

Solubility:

very slightly soluble in water

## BUTYL MALEATE

Synonyms:

dibutyl maleate

maleic acid dibuty  
esterFormula:  $(\text{CHCOOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3)_2$ 

Formula Weight: 228.3

Boiling Point: 141 to 142°C. (at 9 mm.)

## BUTYL MALONATE

Synonyms:

dibutyl malonate

malonic acid  
dibutyl esterFormula:  $\text{CH}_2(\text{COOC}_4\text{H}_9)_2$ 

Formula Weight: 216.3

Boiling Point: 251.5° C. (at 760 mm.)  
Specific Gravity: 1.005(0/0)  
Solubility: insoluble in water  
soluble in alcohol    soluble in ether

BUTYL METHACRYLATE

Synonyms:  
methacrylic acid butyl ester  
Formula:  $\text{CH}_2\text{:C}(\text{CH}_3)\text{COO}(\text{CH}_2)_3\text{CH}_3$   
Formula Weight: 142.2  
Melting Point:  $< -76^\circ \text{C.}$   
Boiling Point:  
163° C.                      163 to 164° C.  
(at 760 mm.)              (at 760 mm.)

Specific Gravity:  
0.895 at 25° C.              0.895(20/20)  
7.45 lbs. per gal.

Refractive Index: 1.426 at 15.6° C.  
Flash Point: 126° F. (open)

Uses: organic syntheses

Solubility:  
water is insoluble in this compound  
insoluble in water  
 $\infty$  (in alcohol)               $\infty$  (in ether)

Additional Data:  
the commercial product contains an inhibitor

BUTYL o-METHOXYBENZOATE

Synonyms:  
o-methoxybenzoic acid butyl ester  
Formula:  
 $\text{CH}_3\text{OC}_6\text{H}_4\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$   
Formula Weight: 208.3

Boiling Point: 185 to 186° C. (at 20 mm.)

BUTYL METHYL ETHER

Synonyms:  
1-methoxybutane              methyl butyl ether  
Formula:  $\text{CH}_3\text{O}(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 88.2  
Melting Point: -115.5  
Boiling Point: 70.3 to 71° C. (at 760 mm.)  
Specific Gravity:  
0.764(0/4)                      0.744(20/4)  
Solubility:  
very slightly soluble in water  
 $\infty$  (in alcohol)               $\infty$  (in ether)

BUTYL METHYL SULFIDE

Synonyms: methyl butyl sulfide  
Formula:  $\text{CH}_3\text{S}(\text{CH}_2)_3\text{CH}_3$   
Formula Weight: 104.2  
Boiling Point: 122 to 124° C. (at 760 mm.)

BUTYL NITRATE

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{ONO}_2$   
Characteristics: ethereal odor  
Formula Weight: 119.1  
Melting Point:  $-60^\circ \text{C.}$   
Boiling Point:  
136° C.                      132 to 155° C.  
(at 760 mm.)              (at 760 mm.)  
Specific Gravity:  
1.048(0/4)                      1.03(20/20)  
Refractive Index:  
1.4013 at 23.2° C.              1.407 at 20° C.

Viscosity (centipoises): 0.79  
Flash Point: 97° F. (closed)  
Solubility: insoluble in water  
soluble in alcohol    soluble in ether  
Additional Data: coefficient of expansion,  
0.00119 per ° C.

sec-BUTYL NITRATE

Synonyms: d-methylpropyl nitrate  
Formula:  $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{ONO}_2$   
Formula Weight: 119.1  
Boiling Point: 124° C. (at 760 mm.)

sec-BUTYL NITRATE (Cont.)

Specific Gravity: 1.0382(0/4)

Solubility:

 $\infty$  (in alcohol)  $\infty$  (in ether)

## BUTYL NITRITE

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{ONO}$ 

Formula Weight: 103.1

Boiling Point: 75 to 79°C. (at 760 mm.)

Specific Gravity: 0.9114(0/4)

Solubility:

 $\infty$  (in alcohol)  $\infty$  (in ether)sec-BUTYL NITRITESynonyms: a-methylpropyl nitriteFormula:  $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{ONO}$ 

Formula Weight: 103.1

Boiling Point: 68°C. (at 760 mm.)

Specific Gravity: 0.8981(0/4)

Solubility:

 $\infty$  (in alcohol)  $\infty$  (in ether)tert-BUTYL NITRITESynonyms: a, a-dimethylethyl nitriteFormula:  $(\text{CH}_3)_3\text{CONO}$ 

Characteristics: pale yellow

Formula Weight: 103.1

Boiling Point: 63°C. (at 760 mm.)

Specific Gravity: 0.8941(0/4)

Solubility:

slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether  
 soluble in chloroform  
 soluble in carbon disulfide

## BUTYL OLEATE

Synonyms:

oleic acid butyl ester      butyl 9-octa-  
 decenoate

Formula:  $\text{C}_{17}\text{H}_{33}\text{COO}(\text{CH}_2)_3\text{CH}_3$ 

Characteristics:

light colored      mild odor

Formula Weight: 338.6

Melting Point:

opaque at 12°C.      solid at -26.4°C.

Boiling Point:

173 to 227°C. (at 760 mm.)

227 to 228°C. (at 15 mm.)

180 to 195°C. (at 2 mm.)

173 to 235°C. (at 75 mm.)

Specific Gravity

0.868 at 25°C.      0.873(20/20)

7.26 lbs. per gal. at 20°C.

Flash Point: 356°F. (open)

Uses:

coating and waterproofing compounds  
 lubricant      polishes  
 plasticizer      water resisting  
 agent

Solubility:

insoluble in water  
 water is insoluble in this compound  
 soluble in alcohol      soluble in ether  
 miscible with vegetable and mineral  
 oils

Additional Data: iodine value, 76.8

## BUTYL ORTHOFORMATE

Synonyms: tributyl orthoformate

Formula:  $\text{HC}(\text{OCH}_2\text{CH}_2\text{C}_2\text{H}_5)_3$ 

Formula Weight: 232.4

Boiling Point: 245 to 247°C. (at 760 mm.)

Specific Gravity: 0.869(20/4)

## BUTYL OXALATE

Synonyms:

butyl ethanedioate      dibutyl oxalate  
 dibutyl ethanedi-  
 oate

Formula:  $[\text{COO}(\text{CH}_2)_3\text{CH}_3]_2$ 

Characterisitics: mild odor

Formula Weight: 202.2

Melting Point:  $-29.6^{\circ}\text{C}$ .

Boiling Point:

$243^{\circ}\text{C}$ .  $240$  to  $255^{\circ}\text{C}$ .  
(at 760 mm.) (at 760 mm.)

Specific Gravity:

1.010(0/0) 0.989 to  
0.993(20/20)  
8.24 lbs. per gal. at  $20^{\circ}\text{C}$ .

Refractive Index: 1.425

Viscosity:

10% 1/2 sec. nitrocellulose solution  
800

Flash Point:

$246^{\circ}\text{F}$ . (open)  $220^{\circ}\text{F}$ . (closed)

Uses:

nitrocellulose solvent in printing inks  
organic syntheses

Solubility:

0.5 cc. of water in 100 cc. of solvent  
at  $25^{\circ}\text{C}$ .

insoluble in water soluble in ether  
soluble in alcohol  
miscible with most alcohols, esters,  
hydrocarbons, oils, and ketones

Additional Data: coefficient of expansion,  
0.00053 per  $^{\circ}\text{F}$ . 0.00095 per  $^{\circ}\text{C}$ .

Dilution Ratios

(Nitrocellulose Solution Method)

With toluene . . . . . 2.3

With petroleum naphtha . . . . . 1.0

Blush Resistance at  $90^{\circ}\text{F}$ .

(10% 1/2 sec. RS Nitrocellulose Solution)

Clear Blush

Relative humidity 80% ...

$\beta$ -(p-tert BUTYLPHENOXY) -ETHANOL

Formula:  $(\text{CH}_3)_3\text{CC}_6\text{H}_4\text{OCH}_2\text{CH}_2\text{OH}$

Characteristics:

nearly odorless straw colored  
colorless to pale viscous  
yellow

Formula Weight: 194.3

Melting Point:  $13^{\circ}\text{C}$ .

Boiling Point:  $145$  to  $156^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.014(25/25)

Viscosity (centipoises):

42.0 at  $38^{\circ}\text{C}$ . 11.6 at  $60^{\circ}\text{C}$ .

Flash Point:  $248^{\circ}\text{F}$ . (open)

Solubility:

insoluble in water  
 $\infty$  (in acetone)  $\infty$  (in benzene)  
 $\infty$  (in ether) soluble in carbon  
 $\infty$  (in methyl tetrachloride  
alcohol)

Additional Data: fire point,  $302^{\circ}\text{F}$ .

$\beta$ -(p-tert BUTYLPHENOXY)  
-ETHYL ACETATE

Synonyms:

2-(4-tert butylphenoxy)ethyl acetate

Formula:

$(\text{CH}_3)_3\text{CC}_6\text{H}_4\text{OCH}_2\text{CH}_2\text{OCOCH}_3$

Characteristics:

mild odor colorless to straw  
colored

Formula Weight: 236.3

Melting Point:  $<-25^{\circ}\text{C}$ .

Boiling Point:  $304$  to  $307^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.024(25/25)

Flash Point:  $324^{\circ}\text{F}$ . (open)

Solubility:

insoluble in water  $\infty$  (in benzene)  
 $\infty$  (in acetone)  $\infty$  (in carbon  
 $\infty$  (in ether) tetrachloride)  
 $\infty$  (in methyl  
alcohol)

Additional Data: fire point,  $334^{\circ}\text{F}$ .

BUTYL PHENYL ETHER

Synonyms: butoxybenzene

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{OC}_6\text{H}_5$

Characteristics: aromatic odor

Formula Weight: 150.2

## BUTYL PHENYL ETHER (Cont.)

## Boiling Point:

210.3° C. (at 760 mm.)  
 98 to 99° C. (at 10 mm.)  
202 to 212° C. (at 760 mm.)  
208 to 211° C. (at 760 mm.)

## Specific Gravity:

0.9215 to 0.929(20/20)  
 0.930(20/4)

## Refractive Index:

1.5046 1.497

Viscosity (centipoises): 1.78 at 25° C.Flash Point: 180° F. (open)

## Uses: cellulose acetate plasticizer

Solubility: insoluble in water  
 soluble in alcohol soluble in ether

Additional Data: coefficient of expansion,  
0.00088 per ° C.

## BUTYL PHENYLMETHANOL

Synonyms: butylphenylcarbinol

Formula:  $C_6H_5CHOH(CH_2)_3CH_3$

Formula Weight: 164.2

Boiling Point: 128 to 130° C. (at 8 mm.)

## BUTYL PROPIONATE

## Synonyms:

butyl propanoate  
 propionic acid butyl ester

Formula:  $C_2H_5COO(CH_2)_3CH_3$

## Characteristics:

apple-like odor very sweet taste  
 weak rose-like odor apricot flavor  
 odor

Formula Weight: 130.2

Melting Point: -89.55° C.

## Boiling Point:

145 to 146° C. (at 760 mm.)  
 130 to 150° C. (at 760 mm.)  
124 to 171° C. (at 760 mm.)

## Specific Gravity:

0.8828 at 15° C. 0.874 to 0.875  
 at 20° C.  
7.27 lbs. per gal. at 20° C.

## Viscosity (centipoises):

10% 1/2 sec. nitrocellulose solution  
59

## Flash Point:

110° F. (open) 90° F. (closed)

## Uses:

solvent for nitrocellulose, lacquers  
 retarder for lacquer thinners  
 limited use as apricot and peach  
 flavor

## Solubility (per cent by weight):

0.80 (of water) ∞ (in alcohol)  
0.15 (in water) ∞ (in ether)  
 miscible with all coal tar and  
 petroleum distillates

Additional Data: coefficient of expansion,

0.00106 at 0.00060 per ° F.  
 10 to 30° C.

vapor density, 5.00

autoignition temperature, 800° F.

## Evaporation Rate at 95° F.

%	Minutes
5 . . . .	<u>2 1/2</u>
25 . . . .	<u>12</u>
50 . . . .	<u>24 3/4</u>
75 . . . .	<u>41 1/2</u>
90 . . . .	<u>56 1/2</u>
95 . . . .	<u>63 1/4</u>

## Dilution Ratios

(Nitrocellulose Solution Method)

With toluene . . . . . 2.1  
 With petroleum naphtha . . . . . 1.2

## Blush Resistance at 90° F.

10% 1/2 sec. RS Nitrocellulose Solution  
 Clear Blush  
 Relative humidity 85% 90%

sec-BUTYL PROPIONATE

## Synonyms:

sec-butyl propanoate  
 propionic acid sec-butyl ester

Formula:  $C_2H_5COOCH(CH_3)C_2H_5$

Formula Weight: 130.2

Boiling Point:

132.0 to 132.5° C. (at 760 mm.)

Specific Gravity: 0.866(20/4)

Solubility: insoluble in water

∞ (in alcohol) ∞ (in ether)

### N-BUTYLPYRROLE

Formula:  $C_4H_4NC_4H_9$

Characteristics: yellow

Formula Weight: 123.2

Boiling Point: 91 to 92° C. (at 55 mm.)

### BUTYL RICINOLEATE

Synonyms:

butyl 12-hydroxy-9-octadecenoate  
ricinoleic acid butyl ester

Formula:  $HOC_{17}H_{32}COO(CH_2)_3CH_3$

Characteristics:

yellow oleaginous

Formula Weight: 354.6

Melting Point:

slightly opaque very viscous at  
at -30° C. -50° C.

Boiling Point: 275° C. (at 13 mm.)

Specific Gravity:

0.906(22/4) 0.916(20/20)  
7.62 lbs. per gal. at 20° C.

Viscosity (Saybolt): 112 at 100° F.

Flash Point: 230° F. (closed)

Uses:

plasticizer lubricant

Solubility: insoluble in water

soluble in alcohol soluble in ether

### BUTYL SALICYLATE

Synonyms:

butyl o-hydroxybenzoate  
o-hydroxybenzoic acid butyl ester  
salicylic acid butyl ester

Formula:  $HOC_6H_4COO(CH_2)_3CH_3$

Formula Weight: 194.2

Melting Point: 5.9° C.

Boiling Point: 259 to 260° C. (at 760 mm.)

### BUTYL SEBACATE

Synonyms:

dibutyl sebacate  
sebacic acid dibutyl ester

Formula:  $[(CH_2)_4COOC_4H_9]_2$

Characteristics:

nearly tasteless pleasant odor  
mild

Formula Weight: 314.5

Melting Point: -8° C.

Boiling Point:

344 to 345° C. (at 760 mm.)  
175 to 180° C. (at 3 mm.)

Specific Gravity:

0.933 at 15° C. 0.933(20/20)  
7.79 lbs. per gal. at 68° F.

Refractive Index: 1.4423

Flash Point: 353° F. (open)

Uses:

solvent for cellulose derivatives,  
chlorinated rubber, nitrocellulose  
perfume fixative  
plasticizer for many resins  
anti-foaming cosmetics  
agents

Solubility (per cent by weight):

0.2 (of water) insoluble in  
at 25° water

soluble in acetone, Carbitol, ether,  
alcohol, methyl Cellosolve, mineral  
spirits, toluene, and xylene

Additional Data:

fire point, 420° F.  
dielectric constant, 3.6  
power factor, 60 cycles, 6

## BUTYL STEARATE

## Synonyms:

butyl octadecanoate  
stearic acid butyl ester

Formula:  $C_{17}H_{35}COO(CH_2)_3CH_3$

## Characteristics:

nearly odorless      light straw color

Formula Weight: 340.6

## Melting Point:

27.5° C.      19.5° C.

Boiling Point: 220 to 225° C. (at 25 mm.)

## Specific Gravity:

0.855(25/25)       $\frac{0.855 \text{ to } 0.860(20/20)}{7.14 \text{ lbs. per gal. at } 68^\circ \text{ F.}}$

Refractive Index: 1.4430

## Flash Point:

370 to 385° F.      320° F. (closed)  
(open)

## Heat of Fusion (gram-calories per g.):

39 to 40

## Uses:

solvent for crude rubber and resins  
used in lacquers      polishes  
cosmetic products      synthetic rubber

## Solubility:

0.03% by volume (of water) at 25° C.  
0.29 g. (in water) at 25° C.  
soluble in alcohol      soluble in ether  
miscible with mineral and vegetable  
oils

## Additional Data:

coefficient of expansion,  
 $\frac{0.00046 \text{ per } ^\circ \text{ F.}}{\text{approximate change in weight per gal. per } ^\circ \text{ F., } 0.0033 \text{ pound}}$        $\frac{0.00083 \text{ per } ^\circ \text{ C.}}$

## BUTYL SUCCINATE

## Synonyms:

dibutyl succinate      succinic acid  
butyl ester

Formula:  $(CH_2COOC_4H_9)_2$

Formula Weight: 230.3

Melting Point: -29.3° C.

Boiling Point: 274.5° C. (at 760 mm.)

Specific Gravity: 0.965 at 20° C.

sec-BUTYL SUCCINATE

## Synonyms:

di-sec-butyl succinate  
succinic acid sec-butyl ester

Formula:  $(CH_2COOC_4H_9)_2$

Formula Weight: 230.3

Boiling Point: 256 to 257° C. (at 750 mm)

Specific Gravity: 0.974(20/4)

## BUTYL SULFATE

## Synonyms: dibutyl sulfate

Formula:  $[CH_3(CH_2)_3]_2SO_4$

Formula Weight: 210.3

## Boiling Point:

130 to 132° C.      97.4° C.  
(at 11 mm.)      (at 3 mm.)

Specific Gravity: 1.0591(25/25)

Refractive Index: 1.4210 at 25° C.

Solubility: insoluble in water

## BUTYL SULFIDE

## Synonyms:

butylthiobutane      dibutyl sulfide

Formula:  $[CH_3(CH_2)_3]_2S$

Formula Weight: 146.3

Melting Point: -79.7° C.

Boiling Point: 182 to 189° C. (at 760 mm)

## Specific Gravity:

0.839(16/0)      0.852(0/4)

Solubility: insoluble in water

very soluble in      very soluble in  
alcohol      ether

sec-BUTYL SULFIDE

Synonyms:  
di-sec-butyl sulfide  
1-methyl-1-(d-methyl propylthio)-  
propane

Formula:  $[C_2H_5CH(CH_3)]_2S$

Formula Weight: 146.3

Boiling Point: 165° C. (at 760 mm.)

Specific Gravity: 0.8317(23/4)

Solubility: insoluble in water  
very soluble in alcohol      very soluble in ether

BUTYL SULFITE

Synonyms: dibutyl sulfite

Formula:  $(CH_3CH_2CH_2CH_2O)_2SO$

Formula Weight: 194.3

Boiling Point: 108 to 110° C. (at 15 mm.)

BUTYL TARTRATE

Synonyms:  
dibutyl tartrate  
tartaric acid butyl ester  
dibutyl 2,3-dihydroxybutanedioate

Formula:  $(COOC_4H_9)_2(CHOH)_2$

Characteristics: light straw color

Formula Weight: 262.3

Melting Point:  
22 to 22.5° C.      21° C.

Boiling Point:  
200 to 203° C.      204° C.  
(at 18 mm.)      (at 26 mm.)

Specific Gravity:  
1.098 at 15° C.  
1.087 to 1.093(20/20)  
9.07 lbs. per gal. at 68° F.

Refractive Index:  
1.4636 at 21.5° C.      1.4463

Flash Point:  
230 to 270° F.      195° F.  
(open)      (closed)

Uses:  
solvent for cellulose acetate, nitro-cellulose, dopes, lubricants, lacquers, plastics, plasticizers, resins, and rubberized fabrics

Solubility:  
miscible with common organic solvents, oils, and hydrocarbons

Additional Data: vapor density, 9.03

BUTYL THIOCYANATE

Synonyms:  
butyl rhodanate      thiocyanic acid  
butyl sulfocyanate      butyl ester

Formula:  $CH_3(CH_2)_3SCN$

Formula Weight: 115.2

Boiling Point: 185 to 186° C. (at 760 mm.)

Specific Gravity: 0.956 at 25° C.

Refractive Index: 1.4636 at 21.5° C.

Solubility: insoluble in water  
soluble in alcohol      soluble in ether

tert-BUTYL THIOCYANATE

Synonyms:  
tert-butyl rhodanate      tert-butyl sulfocyanate

Formula:  $(CH_3)_3CSCN$

Characteristics: oily

Formula Weight: 115.2

Boiling Point: decomposes

Solubility: insoluble in water  
slightly soluble in alcohol      soluble in ether

2-tert-BUTYL THIOPHENE

Formula:   $C(CH_3)_3$

Formula Weight: 140

Boiling Point: 165 to 166° C. (at 760 mm.)

Specific Gravity: 0.947(20/4)

Refractive Index: 1.4984

2-tert-BUTYL THIOPHENE (Cont.)

Uses: organic syntheses

Additional Data: 95% pure

BUTYL a-TOLUATE

Synonyms:

butyl phenyl-	<u>a</u> -toluic acid
acetate	butyl ester

Formula:  $C_6H_5CH_2COOC_4H_9$ 

Formula Weight: 192.3

Boiling Point: 128 to 132° C. (at 18 mm.)

Solubility: insoluble in water  
soluble in alcohol      soluble in etherm-BUTYLTOLUENE

Synonyms:

1-methyl-3-butylbenzene
<u>m</u> -methylbutylbenzene

Formula:  $CH_3C_6H_4(CH_2)_3CH_3$ 

Characteristics: oily

Formula Weight: 148.2

Boiling Point: 197 to 198° C. (at 760 mm.)

Specific Gravity:

0.861(20/4)	0.8624(18/4)
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Solubility: insoluble in water  
slightly soluble      soluble in ether  
in alcoholo-BUTYLTOLUENE

Synonyms:

1-methyl-2-	<u>o</u> -methylbutyl-
butylbenzene	benzene

Formula:  $CH_3C_6H_4(CH_2)_3CH_3$ 

Characteristics: oily

Formula Weight: 148.2

Boiling Point: 200 to 201° C. (at 760 mm.)

Specific Gravity: 0.8702(18/4)

Solubility: insoluble in water  
slightly soluble      soluble in ether  
in alcoholp-BUTYLTOLUENE

Synonyms:

1-methyl-4-	<u>p</u> -methylbutyl-
butylbenzene	benzene

Formula:  $CH_3C_6H_4(CH_2)_3CH_3$ 

Characteristics: oily

Formula Weight: 148.2

Boiling Point: 198 to 199° C. (at 760 mm.)

Specific Gravity:

0.86132(14/4)	0.864(20/4)
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Solubility: insoluble in water  
slightly soluble      soluble in ether  
in alcoholBUTYL p-TOLUENESULFONATEFormula:  $CH_3C_6H_4SO_2O(CH_2)_3CH_3$ 

Formula Weight: 228.3

Boiling Point: 174 to 175° C. (at 10 mm.)

Specific Gravity: 1.120(20/4)

BUTYL m-TOLYL ETHER

Synonyms:

3-butoxytoluene	butyl <u>m</u> -cresyl
	ether

Formula:  $CH_3C_6H_4O(CH_2)_3CH_3$ 

Formula Weight: 164.2

Boiling Point: 229.2° C. (at 760 mm.)

Specific Gravity: 0.9407(0/0)

BUTYL o-TOLYL ETHER

Synonyms:

2-butoxytoluene	butyl <u>o</u> -cresyl
	ether

Formula:  $CH_3C_6H_4O(CH_2)_3CH_3$ 

Formula Weight: 164.2

Boiling Point: 233.0° C. (at 760 mm.)

BUTYL p-TOLYL ETHER

## Synonyms:

4-butoxytoluene  
butyl p-cresyl ether

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{O}(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 164.2

Boiling Point: 229° C. (at 760 mm.)

Specific Gravity: 0.9419(0/0)

N-BUTYLURETHANE

## Synonyms:

butyl urethane  
carbamic acid butylethyl ester  
ethyl N-butylcarbamate

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{NHCOOC}_2\text{H}_5$ 

Characteristics: fruity odor

Formula Weight: 145.2

Melting Point: -22° C.

Boiling Point:

202 to 203° C. (at 760 mm.)

205 to 213° C. (at 760 mm.)

Specific Gravity:

0.951 at 15° C. 0.947(20/20)Refractive Index: 1.431Viscosity (centipoises): 6.67 at 25° C.Flash Point: 197° F. (closed)

Solubility:

soluble in alcohol      soluble in ether

Additional Data: coefficient of expansion,  
0.00097 per ° C.

## BUTYL VALERATE

## Synonyms:

butyl pentanoate      valeric acid  
butyl valerate      butyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{COO}(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 158.2

Melting Point: -92.8° C.

Boiling Point: 185.6° C. (at 760 mm.)

Specific Gravity: 0.870(15/4)

Solubility:

very slightly soluble in water  
∞ (in alcohol)      ∞ (in ether)

## BUTYL VINYL ETHER

Synonyms: vinyl butyl ether

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OCH}:\text{CH}_2$ 

Characteristics: ethereal odor

Formula Weight: 100.2

Melting Point: -92° C.

Boiling Point:

93.3 to 93.8° C. (at 760 mm.)Vapor Pressure: 0.8 psia at 70° F.Specific Gravity: 0.7727 at 25° C.Refractive Index: 1.3997 at 25° C.Flash Point: 300° F. (open)

Specific Heat (gram-calories per g.  
per ° C.): 0.553 (liquid) at 25° C.

Uses: organic syntheses

Solubility (per cent):

0.40 (of water)      soluble in alcohol  
0.1 (in water)      soluble in ether

Additional Data:

technical product contains triethanol-  
amine as a stabilizing agent and can  
be purified by washing with water,  
drying with a neutral or alkaline  
medium and breaking with metallic  
sodium

## 1-BUTYNE

Synonyms:

1-butine      ethylacetylene

Formula:  $\text{C}_2\text{H}_5\text{C}:\text{CH}$ 

Formula Weight: 54.1

Melting Point: -130° C.

Boiling Point: 8.9° C. (at 760 mm.)

Specific Gravity: 0.668(0/4)

## 1-BUTYNE (Cont.)

Refractive Index: 1.3962

Solubility: insoluble in water  
soluble in alcohol    soluble in ether

## 2-BUTYNE

## Synonyms:

2-butine                      dimethyl-  
crotonylene                acetyleneFormula:  $\text{CH}_3\text{C}:\text{CCH}_3$ 

Formula Weight: 54.1

## Boiling Point:

27.2° C.                      27 to 28° C.  
(at 760 mm.)                (at 735 mm.)

Specific Gravity: 0.688 at 25° C.

Refractive Index: 1.3893 at 25° C.

Solubility: insoluble in water  
soluble in alcohol    soluble in ether

## BUTYRALDEHYDE

## Synonyms:

butaldehyde                butyl aldehyde  
butanal                      butyric aldehydeFormula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ 

## Characteristics:

characteristic pungent aldehyde odor  
inflammable

Formula Weight: 72.1

Melting Point: -99° C.

## Boiling Point:

75.7° C. (at 760 mm.)  
70 to 86° C. (at 760 mm.)  
75 to 76° C. (at 760 mm.)

## Vapor Pressure (mm. Hg):

91.5 at 20° C.

## Specific Gravity:

0.817(20/4)                      0.8048(20/20)  
6.7 lbs per gal. at 20° C.

Refractive Index: 1.3843

## Flash Point:

64° F. (open)                      20° F. (closed)

## Uses:

manufacture of butyric acid and many  
other organic compounds  
drugs                      perfumes  
flavor for synthetic alcoholic  
beverages  
rubber accelerators

## Solubility (grams per 100 ml.):

3 (of water)                      soluble in oils  
4 (in water)                      soluble in most  
 $\infty$  (in alcohol)                      organic solvents  
 $\infty$  (in ether)

## Additional Data:

vapor density, 2.48  
change in weight per gallon per ° F.,  
0.0045 pound

## BUTYRALDEHYDE OXIME

## Synonyms:

butanal oxime                      butyraldoxime

Formula:  $\text{C}_2\text{H}_5\text{CH}_2\text{CH:NOH}$ 

Formula Weight: 87.1

Melting Point: -29.5° C.

Boiling Point: 152° C. (at 715 mm.)

Specific Gravity: 0.923(20/4)

Flash Point: 136° F. (closed)

## Solubility (grams per 100 ml.):

10.8 (in water)                       $\infty$  (in alcohol)  
 $\infty$  (in ether)

Additional Data: vapor density, 3.01

## BUTYRALDEHYDE TRIMER

## Synonyms: p-butyraldehyde

Formula:  $(\text{C}_3\text{H}_7\text{CHO})_3$ 

Characteristics: oily

Formula Weight: 216.3

Melting Point: &lt; -20° C.

## Boiling Point:

115 to 117° C. (at 17 mm.)  
98 to 100° C. (at 35 mm.)

Specific Gravity: 0.918

BUTYRIC ACID

Synonyms:  
butanoic acid                      propylformic acid  
ethylacetic acid

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

Characteristics:  
oily, limpid liquid  
sharp, disagreeable, rancid odor

Formula Weight: 88.1

Melting Point:  $-4.7$  to  $-7.9^\circ\text{C}$ .

Boiling Point:  
 $162^\circ\text{C}$ . (at 760 mm.)  
 $163.5^\circ\text{C}$ . (at 757 mm.)  
 $158$  to  $165^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure (mm. Hg):  $0.5$  at  $20^\circ\text{C}$ .

Specific Gravity:  
 $0.9587$  to                       $0.9590(20/20)$   
 $0.964(20/4)$   
 $8$  lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:  $1.39906$

Surface Tension (dynes per cm.):  
 $28.8$  at  $0^\circ\text{C}$ .                       $19.5$  at  $100^\circ\text{C}$ .  
 $26.8$  at  $20^\circ\text{C}$ .

Flash Point:  $170^\circ\text{F}$ . (closed)

Heat of Vaporization (gram-calories per g.):  $114.0$  at  $15^\circ\text{C}$ .

Heat of Fusion (gram-calories per g.):  $30.1$  at  $15^\circ\text{C}$ .

Heat of Combustion (kilogram-calories per g.):  $524.3$  (liquid)

Uses:  
component of synthetic butter, butter-scotch, hops, pineapple, pistachio, melon and walnut flavors  
for use in candies, liqueurs, sirups, and cake  
butyrates                      disinfectants  
drugs                              varnishes  
esters                              water purification

Solubility:  
 $\infty$  (of water)                       $\infty$  (in alcohol)  
 $\infty$  (in water)                       $\infty$  (in ether)  
miscible with most organic reagents

Additional Data:  
freezes at  $-19^\circ\text{C}$ .  
vapor density,  $3.04$   
acid number (neutralization value),  $636.8$   
critical temperature,  $355^\circ\text{C}$ .  
critical pressure,  $52.0$  atm.

BUTYRIC ANHYDRIDE

Synonyms: .  
butanoic anhydride    butyryl oxide

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CO})_2\text{O}$

Characteristics:  
irritating pungent odor

Formula Weight:  $158.2$

Melting Point:  
 $-75^\circ\text{C}$ .                              ( $-56.1^\circ\text{C}$ .)

Boiling Point:  
 $198$  to  $199.5^\circ\text{C}$ .                       $190$  to  $195^\circ\text{C}$ .  
(at 760 mm.)                              (at 760 mm.)

Vapor Pressure (mm. Hg):  $0.37$  at  $20^\circ\text{C}$ .

Specific Gravity:  
 $0.9681(20/20)$                        $0.9946(20/4)$   
 $8.1$  lbs. per gal. at  $20^\circ\text{C}$ .

Flash Point:  $190^\circ\text{F}$ . (closed)

Uses:  
butyrates                              drugs  
cellulose aceto-                      tanning com-  
butyrate                                  ponent

Solubility:  
the addition of water to this compound causes decomposition  
decomposes in water  
slight decomposition in alcohol  
 $\infty$  (in ether)

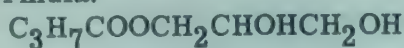
Additional Data:  
hydrolyzes with water to butyric acid  
vapor density,  $5.38$

BUTYRIN

Synonyms:  
glycerol mono-                      monobutyryn  
butyrate

## BUTYRIN (Cont.)

Formula:



Formula Weight: 162.2

Boiling Point: 269 to 271° C. (at 760 mm.)

Specific Gravity: 1.09

Solubility: ∞ (in water)

## BUTYROLACTONE

Synonyms:

butanolide

4-hydroxybutanoic acid lactone

γ-hydroxybutyric acid γ-lactone

Formula:  $\text{CH}_2\text{CH}_2\text{CH}_2\text{COO}$ 

Characteristics: oily

Formula Weight: 86.1

Boiling Point: 206° C. (at 760 mm.)

Specific Gravity: 1.1286(15/0)

Solubility:

∞ (in water)

soluble in alcohol

soluble in ether

## BUTYRONE

Synonyms:

dipropyl ketone

4-heptanone

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{CO}$ 

Characteristics: pleasant odor

Formula Weight: 114.2

Melting Point: -32.6 to -34° C.

Boiling Point:

144° C.

(at 760 mm.)

138 to 144° C.

(at 760 mm.)

Vapor Pressure (mm Hg): 5.2 at 20° C.

Specific Gravity:

0.8174(20/4)

0.822(20/4)

6.79 lbs. per gal. at 20° C.

Refractive Index:

1.40732

1.4068

Surface Tension (dynes per cm.):

25.2 at 25° C.

Flash Point: 120° F. (closed)

Specific Heat (gram-calories per g.  
per ° C.): 0.553 at 25° C. (liquid)Heat of Vaporization (gram-calories  
per g.):

75.8 at the boiling point

Heat of Combustion (kilogram-calories  
per mol.): 1051 (liquid)

Uses:

solvent for nitrocellulose, raw and  
blown oils, and resins

lacquers

resin finishes

Solubility:

0.87% by weight (of water)

0.43 g. per 100 ml. (in water)

∞ (in alcohol)

∞ (in ether)

Additional Data:

coefficient of expansion,

0.00107 at 10 to 30° C.

vapor density, 3.93

Dilution Ratio

kemsolene . . . . . 0.8

toluene . . . . . 3.1

Final concn. 1/2 sec. RS Nitro-

cellulose. . . . . 8%

## BUTYRONITRILE

Synonyms:

butanenitrile

propyl cyanide

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$ 

Formula Weight: 69.1

Melting Point: -112.6° C.

Boiling Point:

117 to 118° C.

(at 760 mm.)

117.5° C.

(at 760 mm.)

Specific Gravity:

0.796 at 15° C.

0.794(20/4)

Refractive Index: 1.3816 at 24° C.

Surface Tension (dynes per cm.):

28.7 at 10° C.

18.2 at 110° C.

27.6 at 20° C.

Heat of Vaporization (gram-calories  
per g.): 114.9 at 15° C.

Heat of Combustion (kilogram-calories per g.-mol): 613.3 (liquid)

Solubility: slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

### BUTYROPHENONE

Synonyms:

butyrylbenzene	propyl phenyl
phenyl propyl	ketone
ketone	

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COC}_6\text{H}_5$

Characteristics: nutty flavor

Formula Weight: 148.2

Melting Point:  $11^\circ\text{C}$ .

Boiling Point:

$232.3^\circ\text{C}$ .	$231^\circ\text{C}$ .
(at 760 mm.)	(at 727 mm.)

Specific Gravity:

0.988(20/4)	0.990(18/4)
-------------	-------------

Refractive Index: 1.5202 at  $18^\circ\text{C}$ .

Uses:

hazelnut, walnut and similar nut-like  
 flavor compositions

Solubility: insoluble in water

$\infty$  (in alcohol)  $\infty$  (in ether)

### BUTYRYL BROMIDE

Synonyms: butanoyl bromide

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COBr}$

Formula Weight: 151.0

Boiling Point:  $128^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.4162(17/4)

### BUTYRYL CHLORIDE

Synonyms: butanoyl chloride

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCl}$

Characteristics:

characteristic pungent odor of acid  
 chlorides

Formula Weight: 106.6

Melting Point:  $-89^\circ\text{C}$ .

Boiling Point:

99 to $102^\circ\text{C}$ .	90 to $110^\circ\text{C}$ .
(at 760 mm.)	(at 760 mm.)

Specific Gravity: 1.028(20/4)

Refractive Index: 1.41209

Uses: chemical intermediate

Solubility:

decomposes in	$\infty$ (in ether)
water	
decomposes in	
alcohol	

## C

## CADAVERINE

## Synonyms:

pentamethylene diamine      1, 5-pentanediamine

Formula:  $\text{H}_2\text{N}(\text{CH}_2)_5\text{NH}_2$

## Characteristics:

syrupey      fumes in air

Formula Weight: 102.2

Melting Point:  $9^\circ\text{C}$ .

Boiling Point: 178 to  $180^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.873(25/4)      0.9174(0/4)

## Solubility:

very soluble in water  
very soluble in alcohol  
slightly soluble in ether

## CAPRALDEHYDE

## Synonyms:

capric aldehyde      decanal  
capraldehyde      decyl aldehyde

Formula:  $\text{CH}_3(\text{CH}_2)_8\text{CHO}$

## Characteristics:

pleasant odor of orange flowers      weak sweet taste waxy aroma

Formula Weight: 156.3

Melting Point: 18 to  $20^\circ\text{C}$ .

## Boiling Point:

208 to  $209^\circ\text{C}$ .       $208.5^\circ\text{C}$ .  
(at 760 mm.)      (at 760 mm.)

Specific Gravity: 0.828 at  $15^\circ\text{C}$ .

Refractive Index: 1.4298 at  $15^\circ\text{C}$ .

## Uses:

honey, lemon and orange flavor  
butter, butterscotch and cherry  
essences

Solubility: insoluble in water  
soluble in alcohol      soluble in ether

## CAPRIC ANHYDRIDE

## Synonyms:

decanoic anhydride      decylic anhydride

Formula:  $[\text{CH}_3(\text{CH}_2)_8\text{CO}]_2\text{O}$

Formula Weight: 326.51

Melting Point:  $23.9^\circ\text{C}$ .

Solubility: insoluble in water

soluble in alcohol      soluble in ether

## CAPRINITRILE

## Synonyms:

capric nitrile      nonyl cyanide  
decanenitrile

Formula:  $\text{CH}_3(\text{CH}_2)_8\text{CN}$

Formula Weight: 153.3

Melting Point:  $-17.9^\circ\text{C}$ .

## Boiling Point:

$243.7^\circ\text{C}$ .       $236$  to  $237^\circ\text{C}$ .  
(at 760 mm.)      (at 760 mm.)

Specific Gravity: 0.8295(15/4)

## Solubility:

insoluble in water  
very slightly soluble in alcohol  
soluble in ether

## CAPROALDEHYDE

## Synonyms:

caproic aldehyde      hexoic aldehyde  
hexaldehyde      hexylaldehyde  
hexanal

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CHO}$

## Characteristics:

on great dilution it has a fatty fruity  
odor with a sour note

Formula Weight: 100.2

## Boiling Point:

$128.6$  to  $131^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.834(20/20)                      0.8335(20/4)

## Uses:

synthetic arrac, butter, honey and  
rum flavors

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## Solubility:

5.4% by weight (of water) at 20° C.  
1.1 g. per 100 ml. (in water)  
soluble in alcohol                      soluble in ether  
∞ (in acetone)                      ∞ (in methyl  
∞ (in benzene)                      alcohol)  
∞ (in carbon                      ∞ (in VMP  
tetrachloride)                      naphtha)

## Additional Data:

acid number (neutralization value),  
483.2

## CAPROIC ACID

## Synonyms:

hexanoic acid                      pentylformic acid  
butylacetic acid                      hexylic acid  
capronic acid                      pentiformic acid  
hexoic acidFormula:  $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ 

## Characteristics:

brandy-like flavor                      colorless to  
oily-sweet, soapy                      yellow  
taste  
sweat-like odor which on dilution  
resembles coconut

Formula Weight: 116.2

## Melting Point:

-7.2° C.                      -2.0 to -1.5° C.  
-8.0° C.

Boiling Point: 202.5° C. (at 760 mm.)

## Specific Gravity:

0.929(20/4)                      0.945(0/0)  
7.7 lbs. per gal. at 20° C.

## Refractive Index:

1.4164                      1.419 at 25° C.Flash Point: 215° F. (open)Heat of Combustion (kilogram-calories  
per g.-mol): 831.0 (liquid)

## Uses:

manufacture of hexyl compounds,  
drugs, synthetic flavors  
analytical reagent  
synthetic coconut, butter, brandy, and  
whisky flavors

## CAPROIC ANHYDRIDE

Synonyms: hexanoic anhydride

Formula:  $[\text{CH}_3(\text{CH}_2)_4\text{CO}]_2\text{O}$ 

Characteristics: oily

Formula Weight: 214.3

Melting Point: -40.6° C.

## Boiling Point:

241 to 243° C. (at 760 mm.)  
slight decomposition

Specific Gravity: 0.9279(17/4)

## Solubility:

decomposes in                      soluble in alcohol  
water                      ∞ (in ether)

## CAPRONITRILE

## Synonyms:

amyl cyanide                      hexanenitrile  
caproic nitrileFormula:  $\text{CH}_3(\text{CH}_2)_4\text{CN}$ 

Formula Weight: 97.2

Melting Point: -79.4° C.

## Boiling Point:

163.7° C.                      162 to 163° C.  
(at 760 mm.)                      (at 750 mm.)

Specific Gravity: 0.809(20/4)

Refractive Index: 1.4085 at 14.3° C.

## Solubility:

very slightly soluble in water  
soluble in alcohol                      soluble in ether

## CAPROYL CHLORIDE

Synonyms: hexanoyl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{COCl}$ 

Formula Weight: 134.6

Melting Point:  $-87.3^\circ\text{C}$ .

Boiling Point:

151 to  $153^\circ\text{C}$ . (at 760 mm.)153 to  $154^\circ\text{C}$ . (at 738 mm.)

Specific Gravity: 0.9704(25/4)

Refractive Index: 1.4867

Solubility:

decomposes in water      soluble in ether

decomposes in alcohol

sec-CAPRYL ADIPATE

Synonyms:

adipic acid sec-caprylic esterdi-sec-capryl adipate

Formula:

 $[(\text{CH}_2)_2\text{COOCH}(\text{CH}_3)(\text{CH}_3)_5\text{CH}_3]_2$ 

Characteristics: yellow

Formula Weight: 370.6

Boiling Point: 192 to  $194^\circ\text{C}$ . (at 3 mm.)

## CAPRYLALDEHYDE

Synonyms:

caprylic aldehyde      octylaldehyde

octanal

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CHO}$ 

Characteristics:

sharp, strong odor like that of enanth-aldehyde

bitter taste      rose flavor

weak-cabbage like flavor

Formula Weight: 128.2

Boiling Point:

163.4 $^\circ\text{C}$ .      168.5 $^\circ\text{C}$ .  
(at 760 mm.)      (at 760 mm.)81 $^\circ\text{C}$ . (at 32 mm.)

Specific Gravity: 0.821(20/4)

Refractive Index: 1.4217

Flash Point: 125 $^\circ\text{F}$ . (closed)

Uses:

organic syntheses

synthetic apricot, cherry, and plum flavors

Solubility (g. per 100 g.):

very slightly soluble in water

 $\infty$  (in alcohol)      0.3 (in glycerol) $\infty$  (in ether)

Additional Data:

vapor density, 4.41

solubility in alcohol-water mixtures:

60%      1:10; 70%      7:20;

80%      1:1

## CAPRYL CHLORIDE

Synonyms: decanoyl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_8\text{COCl}$ 

Formula Weight: 190.7

Melting Point:  $-34.5^\circ\text{C}$ .

Boiling Point:

195 to  $196^\circ\text{C}$ .      232.3 $^\circ\text{C}$ .  
(at 760 mm.)      (at 760 mm.)

Specific Gravity: 0.973(8/4)

Solubility:

decomposes in water      soluble in ether

decomposes in ether

## CAPRYLIC ACID

Synonyms:

caprilic acid      octic acid  
hexylacetic acid      octoic acid  
octanoic acid      octylic acidFormula:  $\text{CH}_3(\text{CH}_2)_6\text{COOH}$ 

Characteristics:

oily      bitter, rancid,  
faintly unpleasant      burning taste  
odor  
on dilution the flavor resembles  
brandy

Formula Weight: 144.2

Melting Point: 16°C.

Boiling Point:

237.5°C.                      235 to 237°C.  
(at 760 mm.)                      (at 760 mm.)

Specific Gravity: 0.910(20/4)

Refractive Index: 1.4285

Heat of Fusion (gram-calories  
per g.): 35.4 at 15°C.

Uses:

dyes                      perfumes  
synthetic brandy, butter, coconut and  
honey flavors

Solubility (gram per 100 ml.):

0.25 (in water)                      ∞ (in benzene)  
at 100°C.                      ∞ (in carbon  
∞ (in alcohol)                      disulfide)  
∞ (in ether)                      ∞ (in glacial  
∞ (in chloroform)                      acetic acid)

Additional Data:

crystallizes below 17°C.

#### CAPRYLIC ANHYDRIDE

Synonyms:

octanoic anhydride    octoic anhydride

Formula:  $[\text{CH}_3(\text{CH}_2)_6\text{CO}]_2\text{O}$

Formula Weight: 270.4

Melting Point: -1°C.

Boiling Point: 280 to 285°C. (at 760 mm.)

Specific Gravity: 0.9021(25/4)

Solubility: decomposes in water  
soluble in alcohol    ∞ (in ether)

#### CAPRYLONITRILE

Synonyms:

octanenitrile                      heptyl cyanide

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CN}$

Formula Weight: 125.2

Melting Point: -45.6°C.

Boiling Point:

204.5°C. (at 760 mm.)  
198 to 205.2°C. (at 760 mm.)  
194 to 195°C. (at 760 mm.)

Specific Gravity:

0.820(13/4)                      0.8058(30/4)

Solubility:

insoluble in water  
very slightly soluble in alcohol  
soluble in ether

#### CAPRYLYL CHLORIDE

Synonyms: octanoyl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{COCl}$

Characteristics:

colorless to                      characteristic  
light yellow                      pungent odor

Formula Weight: 162.7

Melting Point: < -70°C.

Boiling Point:

195.6°C. (at 760 mm.)  
194 to 196°C. (at 756 mm.)  
188 to 212°C. (at 760 mm.)

Specific Gravity:

0.973 at 0°C.                      0.9671(0/4)  
0.9576(15.5/15.5)

Refractive Index: 1.4357

Flash Point: 180°F. (open)

Uses: chemical intermediate

Solubility:

decomposes in                      soluble in ether  
water  
decomposes in  
alcohol

Additional Data: fire point, 189°F.

#### "CARBITOL"

Synonyms:

diethylene glycol monoethyl ether  
2-(β-ethoxyethoxy) ethanol

Formula:

$\text{HO}(\text{CH}_2)_2\text{O}(\text{CH}_2)_2\text{OC}_2\text{H}_5$

"CARBITOL" (Cont.)

Characteristics:

mild, pleasant odor    viscous  
slightly hygro-  
scopic

Formula Weight: 134.2

Melting Point:  $< -76^{\circ}\text{C}.$

Boiling Point:

201.9 $^{\circ}\text{C}.$                       185 to 205 $^{\circ}\text{C}.$   
(at 760 mm.)                      (at 760 mm.)

Vapor Pressure (mm. Hg):

0.1 at 20 $^{\circ}\text{C}.$                       <1 at 30 $^{\circ}\text{C}.$

Specific Gravity:

0.990(20/20)                      0.9902(20/4)  
8.2 lbs. per gal. at 20 $^{\circ}\text{C}.$

Refractive Index: 1.4244 at 25 $^{\circ}\text{C}.$

Surface Tension (dynes per cm.):

35.5 at 25 $^{\circ}\text{C}.$

Viscosity (poises): 0.0385 at 25 $^{\circ}\text{C}.$

Flash Point:

210 to 215 $^{\circ}\text{F}.$                       201 $^{\circ}\text{F}.$   
(open)                                      (closed)

Specific Heat (gram-calories per g.

per  $^{\circ}\text{C}.$ ): 0.552 at 20 to 25 $^{\circ}\text{C}.$  (liquid)

Uses:

solvent for nitrocellulose and resins,  
textile dyes, organic syntheses,  
safety glass, and textile soap

Solubility:

$\infty$  (of water)                       $\infty$  (in water)  
miscible with most lacquer diluents

Additional Data:

coefficient of expansion, 0.00082  
at 10 to 30 $^{\circ}\text{C}.$   
latent heat of evaporation, 96.3 gram-  
calories per g. at the boiling point  
electrical conductivity,  
 $2.5 \times 10^{-8}$  mhos at 25 $^{\circ}\text{C}.$   
vapor density, 4.62  
dilution ratios:  
toluene, 1.65                      xylene, 1.2

"CARBITOL" ACETATE

Synonyms:

acetic acid "Carbitol" ester  
diethylene glycol monoethyl ether  
acetate

Formula:  $\text{C}_2\text{H}_5\text{O}(\text{CH}_2)_2\text{O}(\text{CH}_2)_2\text{OOCCH}_3$

Formula Weight: 176.2

Melting Point: -25 $^{\circ}\text{C}.$

Boiling Point:

217.7 $^{\circ}\text{C}.$                                       211 to 220 $^{\circ}\text{C}.$   
(at 760 mm.)                                      (at 760 mm.)

Vapor Pressure (mm. Hg):

0.1 at 20 $^{\circ}\text{C}.$                                       1 at 30 $^{\circ}\text{C}.$

Specific Gravity:

1.011(20/20)                                      1.009(20/4)  
8.4 lbs. per gal. at 20 $^{\circ}\text{C}.$

Refractive Index:

1.418 at 30 $^{\circ}\text{C}.$                                       1.4230 at 20 $^{\circ}\text{C}.$

Flash Point:

230 $^{\circ}\text{F}.$  (open)                                      225 $^{\circ}\text{F}.$  (closed)

Uses:

coatings                                      printing inks  
lacquers                                      surface coatings  
solvent for cellulose esters, gums,  
and resins

Solubility:

$\infty$  (of water)                                       $\infty$  (in ether)  
 $\infty$  (in water)                                       $\infty$  (in alcohol)  
miscible with most organic solvents

Additional Data:

coefficient of expansion, 0.0101  
at 10 to 30 $^{\circ}\text{C}.$   
vapor density, 6.07  
dilution ratios:  
xylene, 1.9; mineral spirits, 1.6

"CARBITOL" CITRATE

Synonyms: citric acid "Carbitol" ester

Characteristics: yellow

Specific Gravity: 1.28

Uses:

plasticizer for nitrocellulose and  
cellulose acetate, water and alcohol  
soluble gums and resins

**Solubility:**

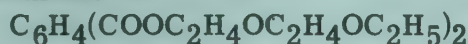
soluble in water, alcohol, acetone, ethyl acetate, cottonseed oil, mineral oil, and naphtha  
partly soluble in toluene

**Additional Data:**

acid value, <30  
saponification value, 350 to 375  
pH (5%), 2.3 at 25° C.

**"CARBITOL" PHTHALATE****Synonyms:**

di-"Carbitol" phthalate  
bis-(diethylene glycol monoethyl ether) phthalate  
ethoxydiglycol phthalate  
phthalic acid "Carbitol" ester

**Formula:****Characteristics:**

mild characteristic odor

Formula Weight: 398

**Melting Point:**

-35° C. forms a very stiff clear gel.

Boiling Point: 200 to 260° C. (at 4 mm.)

**Specific Gravity:**

1.121 to 1.140(20/20)  
9.42 lbs. per gal. at 20° C.

Refractive Index: 1.486 at 25° C.

Flash Point: 405° F. (closed)

**Uses:**

high solvent power  
plasticizer for polyvinyl resins and nitrocellulose

**Solubility:**

4% (of water) at 25° C.  
0.8% (in water) at 25° C.  
2.1% by volume (in 60 Bé. gasoline) at 25° C.  
1 cc. (in mineral oil) at 25° C.  
insoluble or limited solubility in glycerol, some glycols, and some amines  
soluble in most other organic solvents

**Additional Data:**

fire point, 477° F.  
hydrolysis, 0.2% refluxed 2 hours in water  
volatility at 105° C.:  
5.1% after 24 hours  
12.9% after 100 hours  
evaporation rate at 105° C.  
0.0105 g. loss per sq. cm. after 24 hours  
0.0263 g. loss per sq. cm. after 100 hours

**"CARBITOL" RICINOLEATE****Characteristics:**

light amber                      oily

Specific Gravity: 0.96

**Uses:**

plasticizer for nitrocellulose, water- and alcohol soluble gums and resins

**Solubility:**

insoluble in water  
soluble in alcohol, toluene, naphtha, cottonseed oil, acetone, methanol, ethyl acetate  
partly soluble in mineral oil

**Additional Data:**

acid value, <8  
saponification value, 145 to 155  
iodine value, 43 to 48  
titer less than 0° C.

**CARBON DISULFIDE**

Synonyms: carbon bisulfide

Formula:  $\text{CS}_2$

**Characteristics:**

characteristic,	colorless to
pungent odor	faintly yellow
inflammable	highly refractive
	poisonous

Formula Weight: 76.1

**Melting Point:**

-108.6° C.                      -110.8° C.

## CARBON DISULFIDE (Cont.)

## Boiling Point:

46.3° C.                      46.5° C.  
(at 760 mm.)              (at 760 mm.)

## Specific Gravity:

1.2628(20/4)              1.272(15/15)  
1.260(25/25)  
10.6 lbs. per gal. at 15° C.

## Refractive Index:

1.6315 at 15° C.              1.6295 at 18° C.

Surface Tension (dynes per cm.): 32.33

Inflammability Range (volume per cent  
in air): 1.25 (lower limit)

Flash Point: -25 to -22° F. (closed)

Specific Heat (gram-calories per g.  
per ° C.): 0.24 (liquid)

Heat of Vaporization (gram-calories  
per g.):

84.3  
151.7 Btu. per lb. at the boiling point

Heat of Combustion (kilogram-calories  
per g.-mol): 246.6 (liquid)

## Uses:

solvent for fats, gutta percha, oils,  
resins, insecticides, rubber, waxes  
organic syntheses      paraffin  
matches                      preservative  
manufacture  
of CCl<sub>4</sub>  
rubber vulcanization and rubber goods  
varnishes

## Solubility (g. per 100 ml.):

0.2 at 0° C., 0.22 at 22° C.,  
0.14 at 50° C. (in water)  
∞ (in alcohol)              ∞ (in benzene)  
∞ (in ether)  
miscible in nearly all proportions with  
most organic solvents

## Additional Data:

dielectric constant, 1000 cycle 2.60  
power factor, 1000 cycle 0.15  
specific resistivity,  
9.6 x 10<sup>11</sup> ohms per cm.  
weight of pure vapor, 3400 mg. per l.  
vapor density, 2.63

autoignition temperature, 257° F.  
fire point, <39° F.  
critical temperature, 273.00° C.  
critical pressure, 72.9 atm.

## CARBON SUBSULFIDE

Formula: S:C:C:C:S

Characteristics: red

Formula Weight: 100.2

Melting Point: 0.4° C.

Boiling Point: 60 to 70° C. (in vacuo).

Solubility:

very soluble in alcohol, ether, and  
benzene

## CARBON TETRACHLORIDE

Synonyms:

perchloro-	tetrachloro-
methane	methane

Formula: CCl<sub>4</sub>

Characteristics:

aromatic odor	nonexplosive
sharp taste	nonflammable

Formula Weight: 153.8

Melting Point: -22.6° C.

Boiling Point: 76.7° C. (at 760 mm.)

Specific Gravity:

1.595(20/4)                      1.63195(0/4)  
13.22 lbs. per gal. at 25° C.

Refractive Index:

1.4631                              1.4607

Surface Tension (dynes per cm.):

28.0 (in air) at 10° C.  
26.8 (in air) at 20° C.  
20.2 (in air) at 75° C.  
28.2 (in vapor) at 10° C.  
27.0 (in vapor) at 20° C.  
17.3 (in vapor) at 100° C.  
25.4 (in nitrogen) at 25° C.

Viscosity:

1.351 at 0° C.	0.746 at 40° C.
0.975 at 20° C.	0.534 at 70° C.

**Inflammability Range** (volume per cent in air):  
 none (lower limit)    none (upper limit)

**Flash Point:**  
 none (open)            none (closed)

**Specific Heat** (gram-calories per g. per °C.):  
 0.192 (liquid) at 68° F.  
 0.216 (liquid) at 170° F.  
 0.132 (vapor) at 68° F.  
 0.115 (vapor) at 170° F.

**Heat of Vaporization** (gram-calories per g.): 46.5 at 170° F.

**Heat of Fusion** (gram-calories per kilogram): 4.2

**Heat of Combustion** (kilogram-calories per g.-mol): 37.3 (liquid)

**Uses:**

solvent for fats, lacquers, oils, and resins  
 acetic anhydride  
 bone degreasing for glue manufacture  
 chloroform            fabric rubberizing  
 cleaning compound    fumigant  
 cotton waste           insecticides  
   degreasing           lacquers  
 dry cleaning          linoleum  
 dyes                    medicine  
 dry colors            metal polishes  
 electroplating  
 noninflammable benzene and gasoline  
 organic syntheses    printing inks  
 paints                  rubber cements  
 perfume                tallow recovery  
   extraction           varnishes  
 vaporizing liquid for fire extinguishers  
 wax recovery          wool degreasing

**Solubility** (grams per 100 ml.):

0.097 (in water) at 0° C.  
 0.08 (in water) at 20° C.  
 ∞ (in alcohol)        ∞ (in chloroform)  
 ∞ (in ether)          ∞ (in benzene)  
 slightly soluble in glycerol  
 miscible with most organic solvents

of water per 100g.  
 of carbon tetrachloride  
           g.    °C.    °F.  
 0.0071    10     50  
 0.0084    20     68  
 0.0109    30     86  
 0.0152    40    104  
 0.0237    50    122

**Additional Data:**

dielectric constant,  $6.7 \times 10^7$  cycles per sec.  
 2.24 at 20° C.  
 weight of vapor at 170° F. 0.335 lbs. per cu. ft. at 212° F. 0.3135 lbs. per cu. ft.  
 electrical conductivity,  $4 \times 10^{-18}$   
 thermal conductivity, 0.7745 Btu. per sq. ft. per hr., 1° F. per sq. ft. per 1 inch thick  
 thermal expansion of liquid at 158° F., 1.089089  
 on basis of volume at 30° F., 1.0  
 power factor 1000 cycles, 0.057%  
 vapor density, 0.00536 g. per cc. at 76.8° C., 0.00502 g. per cc. at 100° C.  
 critical temperature, 283.1° C.  
 critical pressure, 45.0 atm.  
 heat of vaporization, 83.7 Btu. per lb. at the boiling point  
 weight of pure vapor, 6860 mg. per liter  
 steam distillation point (1 atm.), 66.8° C.  
 solvent: water ratio by weight, 23.5:1  
 diffusivity in air (25° C., 1 atm.), 0.071 per sq. cm. per sec.  
 evaporation rate (ether 100), 33  
 heat of formation:

liquid, 33.8            vapor, 25.9

**Flash Points of CCl<sub>4</sub> Mixtures**

% Solvent	% CCl <sub>4</sub>	Flash Point	° F
Gasoline	50	below	20
Sp. gr. 0.734	40	below	20
at 60° F.	30		40
V.M.P.	70		75
Naphtha	60		100
Sp. gr.	50	above	170
0.764	40	above	170
at 60° F.	30	above	170

## CARBON TETRACHLORIDE (Cont.)

Dry Cleaners	70	30		65
Naphtha	60	40		90
Sp. gr.	50	50	above	170
0.745	40	60	above	170
at 60° F.	30	70	above	170
Acetone	40	60	below	32
	30	70	below	32
	20	80		59
Toluene	80	20		59
	70	30		75
	60	40	above	86

## CARBONYL BROMIDE

## Synonyms:

bromophosgene carbon oxybromide

Formula:  $\text{COBr}_2$ 

Characteristics: strong odor

Formula Weight: 187.8

Melting Point:  $-80^\circ\text{C}$ .Boiling Point:  $64$  to  $65^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 2.45 at  $15^\circ\text{C}$ .

Uses: crystal violet dyes

## Solubility:

very slightly soluble in water

## Additional Data:

carbonyl bromide is hydrolyzed by water and decomposed by heat and light

highly toxic

## CARVACROL

## Synonyms:

2-p-cymenol	isopropyl-o-cresol
cymophenol	2-methyl-5-iso-
2-hydroxy-p-	propylphenol
cymene	oxycymol

Formula:  $(\text{CH}_3)(\text{C}_3\text{H}_7)\text{C}_6\text{H}_3\text{OH}$ 

## Characteristics:

oily thymol odor

Formula Weight: 150.2

## Melting Point:

 $0.5^\circ\text{C}$ . 1 to  $2^\circ\text{C}$ .Boiling Point:  $237$  to  $238^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.977(20/4)

Refractive Index: 1.5223

## Uses:

local anesthetic substitute for thymol

## Solubility:

very slightly soluble in water  
very soluble in alcohol  
very soluble in ether  
soluble in alkalies

## CARVACRYLAMINE

## Synonyms:

2-amino-p-	2-p-cymylamine
cymene	5-isopropyl-2-
cymidine	methylaniline

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_3)\text{C}_6\text{H}_3\text{NH}_2$ 

Characteristics: oily

Formula Weight: 149.2

Melting Point:  $-16^\circ\text{C}$ .

## Boiling Point:

 $241^\circ\text{C}$ . 118° C.  
(at 760 mm.) (at 12 mm.)

Specific Gravity: 0.994(20/4)

Refractive Index: 1.543 at  $19^\circ\text{C}$ .

## Solubility:

very slightly soluble in water  
soluble in alcohol soluble in etherd-CARVONE

## Synonyms:

anise oil	d-6,8(a)-p-men-
carvol	thadien-2-one

Formula:  $\text{C}_{10}\text{H}_{14}\text{O}$ 

## Characteristics:

bitter taste  
caraway odor and flavor

Formula Weight: 150.2

Boiling Point:  $227$  to  $230^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.9608(20/4)

Refractive Index: 1.4999 at 18.2° C.

Uses:

caraway type liqueur flavors and  
essences  
medicines                      toilet soaps

Solubility (grams per 100 ml.):

insoluble in                      ∞ (in alcohol)  
water                              ∞ (in ether)

soluble in chloroform

20 (in 60% alcohol)

one volume is soluble in:

18 volumes of 50% alcohol,  
4 volumes of 60% alcohol,  
2 volumes of 70% alcohol

CEDRENE (synthetic)

Formula:  $C_{15}H_{24}$

Formula Weight: 204.3

Boiling Point: 262 to 263° C. (at 760 mm.)

Specific Gravity: 0.939 at 15° C.

Refractive Index: 1.5001 at 19° C.

"CELLOSOLVE"

Synonyms:

2-ethoxyethanol  
ethylene glycol monoethyl ether

Formula:  $CH_2OHCH_2OC_2H_5$

Characteristics: mild, agreeable odor

Formula Weight: 90.1

Melting Point: -70° C.

Boiling Point:

135.1° C. (at 760 mm.)

132 to 137° C. (at 760 mm.)

Vapor Pressure (mm. Hg):

3.8 at 20° C.                      7.0 at 30° C.

Specific Gravity:

0.9311(20/4)                       $\frac{0.9280 \text{ to } 0.9330(20/20)}$

7.8 lbs. per gal. at 20° C.

Refractive Index:

1.4060 at 25° C.                      1.4080 at 20° C.

Surface Tension (dynes per cm.):

32 at 25° C.

Viscosity (centipoises): 1.861 at 25° C.

Inflammability Range (volume per cent  
in air):

2.6 (lower limit)                      15.7 (upper limit)

Flash Point:

120 to 135° F.                      104° F. (closed)  
(open)

Specific Heat (gram-calories per g.  
per ° C.): 0.555 at 20 to 25° C.

Uses:

solvent of oils, resins, waxes, dopes,  
lacquers, and nitrocellulose  
textile dyeing and printing  
cleaning solutions      varnish remover  
leather finishing

Solubility:

∞ (of water)                      ∞ (in chloroform)  
∞ (in water)                      ∞ (in acetone)  
∞ (in alcohol)                      ∞ (in liquid  
∞ (in ether)                      esters)

Additional Data:

coefficient of expansion,  
 $\frac{0.000097}{\text{at } 10 \text{ to } 30^\circ \text{C.}}$

fire point, 104° F.

electrical conductivity,  $6.88 \times 10^{-6}$

autoignition temperature, 460° F.

vapor density, 3.10

Dilution Ratios

With toluene . . . . . 4.9  
With petroleum naphtha . . . . . 1.1  
With xylene . . . . . 4.3  
With mineral spirits . . . . . 0.7

"CELLOSOLVE" ACETATE

Synonyms:

acetic acid "Cellosolve" ester  
2-ethoxyethanol acetate  
 $\beta$ -ethoxyethyl acetate  
ethylene glycol monoethyl ether acetate

Formula:  $CH_3COOCH_2CH_2OC_2H_5$

Characteristics: ester-like, pleasant odor

Formula: 132.2

"CELLOSOLVE" ACETATE (Cont.)

Boiling Point:

156.3° C. (at 760 mm.)  
150 to 160° C. (at 760 mm.)  
145 to 166° C. (at 760 mm.)

Vapor Pressure (mm. Hg):

1.3 at 20° C.                      3 at 30° C.

Specific Gravity:

0.9749(20/4)                      0.976(15/15)  
8.1 lbs. per gal. at 20° C.

Refractive Index: 1.4030 at 25° C.

Surface Tension (dynes per cm.):

31.8 at 25° C.

Viscosity (centipoises): 1.205 at 25° C.

Inflammability Range (volume per cent in air): 1.71 (lower limit)

Flash Point:

150° F. (open)                      124° F. (closed)

Specific Heat (gram-calories per g. per ° C.): 0.494 at 20 to 25° C.

Uses:

automobile                      varnish removers  
lacquers  
cleaning solutions  
lacquers and lacquer thinners  
textile dyeing and printing  
solvent for nitrocellulose, resins, oils,  
and wood stains

Solubility (per cent by weight):

6.5 (of water) at 22° C.  
22 (in water) at 22° C.  
∞ (in alcohol)                      ∞ (in ether)  
miscible with aromatic hydrocarbons

Additional Data:

coefficient of expansion,  
0.00111 at 10 to 30° C.  
autoignition temperature, 715° F.  
vapor density, 4.72  
electrical conductivity,  $2 \times 10^{-8}$  mhos.

"CELLOSOLVE" CARBONATE

Synonyms: diethoxyethyl carbonate

Formula:  $(C_2H_5OC_2H_4)_2CO_3$

Formula Weight: 206.2

Boiling Point: 124 to 127° C. (at 15 mm.)

"CELLOSOLVE" MALEATE

Synonyms:

diethoxyethyl maleate  
maleic acid "Cellosolve" ester

Formula:  $(:CHCOOC_2H_4OC_2H_5)_2$

Formula Weight: 260.3

Boiling Point: 174 to 177° C. (at 11 mm.)

"CELLOSOLVE" PHTHALATE

Synonyms:

di-"Cellosolve" phthalate  
diethoxyethyl phthalate  
"Ethox"  
ethoxy glycol phthalate  
phthalic acid "Cellosolve" ester

Formula:  $C_6H_4(COOC_2H_4OC_2H_5)_2$

Characteristics: very mild odor

Formula Weight: 310

Melting Point: 31° C.

Boiling Point: 198 to 211° C. (at 4 mm.)

Specific Gravity:

1.120(20/20)  
9.33 lbs. per gal. at 20° C.

Refractive Index: 1.490 at 25° C.

Flash Point: 356° F. (closed)

Uses:

solvent for cellulose acetate, ethyl  
cellulose, nitrocellulose, Parlon, and  
Vinsol  
plasticizer

Solubility:

1.8 grams per 100 ml. (of water)  
at 30° C.  
<3.0% (in water)  
13% by volume (in 60° Be. gasoline)  
at 30° C.  
2 cc. in 100 cc. (in mineral oil)  
at 25° C.  
insoluble or limited solubility in  
glycerol, glycols and some amines

## Additional Data:

volatility } 0.4% after 24 hours  
 at 105° C. } 8.6% after 100 hours

**"CELLOSOLVE" RICINOLEATE**

## Synonyms:

diethoxyethyl ricinoleate  
 ricinoleic acid "Cellosolve" ester

## Characteristics:

oily                                  amber colored

Specific Gravity: 0.88

## Uses:

plasticizer for nitrocellulose and  
 water and alcohol soluble gums and  
 resins

## Solubility:

insoluble in water  
 soluble in acetone, cottonseed oil,  
 ethyl acetate, mineral oil, and  
 naphtha  
 soluble to a certain extent in methyl  
 and ethyl alcohols

## Additional Data:

acid value, <8  
 free fatty acid, 4%  
 iodine value, <65-70  
 saponification number, 150-160  
 titer, <0° C.

**"CELLOSOLVE" SEBACATE**

## Synonyms:

diethoxyethyl sebacate  
 sebacic acid "Cellosolve" ester

## Formula:

$[C_2H_5OC_2H_4OOCCH_2(CH_2)_2CH_2]_2$

Formula Weight: 346.5

Melting Point: -1° C.

Boiling Point: 224 to 226° C. (at 8 mm.)

**"CELLOSOLVE" STEARATE**

## Synonyms:

diethoxyethyl stearate  
 stearic acid "Cellosolve" ester

## Characteristics:

oily                                  amber colored

Specific Gravity: 0.88

## Uses:

plasticizer for nitrocellulose and  
 water-and alcohol soluble gums and  
 resins

## Solubility:

insoluble in water    ∞ (in ether)  
 soluble in alcohol  
 soluble in acetone, cottonseed oil,  
 ethyl acetate, methyl alcohol,  
 naphtha, and toluene

## Additional Data:

acid value, <8  
 free fatty acid, <4%  
 saponification value, 150 to 160  
 iodine value, 4.5  
 titer, 16° C.

**CETENE**

## Synonyms:

1-hexadecene                  β-hexadecylene

Formula:  $CH_3(CH_2)_{13}CH:CH_2$

Formula Weight: 224.4

Melting Point: 4° C.

Boiling Point: 274° C. (at 760 mm.)

## Specific Gravity:

0.784(15/4)                          0.789

Uses: organic syntheses

Solubility: insoluble in water

**CHAVICOL**

Synonyms: p-allylphenol

Formula:  $CH_2:CHCH_2C_6H_4OH$

Formula Weight: 134.2

Melting Point: <-25° C.

Boiling Point: 237° C. (at 760 mm.)

Specific Gravity: 1.033(18/4)

Refractive Index: 1.5441 at 18° C.



Melting Point: 13° C.

Boiling Point: 253 to 265° C. (at 760 mm.)

Specific Gravity: 1.11(20/20)

Refractive Index: 1.532

Surface Tension (dynes per cm.):  
25 at 25° C.

Flash Point: 225° F. (closed)

Additional Data: coefficient of expansion,  
0.00049 per ° C.

**CHLORO-4-tert-AMYLPHENYL  
METHYL ETHER**

Formula:  $C_5H_{11}C_6H_3ClOCH_3$

Characteristics: aromatic odor

Formula Weight: 212.7

Melting Point: -50° C.

Boiling Point: 270 to 276° C. (at 760 mm.)

Specific Gravity: 1.073(20/20)

Refractive Index: 1.526

Surface Tension (dynes per cm.):  
12.0 at 25° C.

Flash Point: 230° F. (closed)

Additional Data: coefficient of expansion,  
0.00086 per ° C.

**m-CHLOROANILINE**

Synonyms:

1-amino-3-chlorobenzene

m-aminochlorobenzene

3-chloraniline

3-chlorophenylamine

Formula:  $ClC_6H_4NH_2$

Characteristics:  
pale yellow                      toxic

Formula Weight: 127.6

Melting Point: -10.4° C.

Boiling Point:  
229.8 to 231° C. (at 760 mm.)  
99 to 100° C. (at 10 mm.)

Specific Gravity:

1.216(20/4)                      1.2223(15/15)

Refractive Index:

1.59424 at 20.7° C.    1.5931

Uses:

intermediate in dye manufacture

Solubility:

insoluble in water    soluble in ether  
∞ (in alcohol)        soluble in acids  
soluble in most organic solvents

Additional Data:

avoid breathing vapor and contact with  
the skin

**o-CHLOROANILINE**

Synonyms:

1-amino-2-chlorobenzene

o-aminochlorobenzene

2-chloraniline

3-chlorophenylamine

Formula:  $ClC_6H_4NH_2$

Characteristics: toxic

Formula Weight: 127.6

Melting Point:

α-14° C.                      mixt. 0° C.  
β-3.5° C.

Boiling Point:

207 to 210.5° C. (at 760 mm.)  
208 to 210° C. (at 760 mm.)

Specific Gravity: 1.213(20/4)

Refractive Index: 1.5895

Uses:

intermediate in dye manufacture

Solubility:

insoluble in water    soluble in ether  
∞ (in alcohol)        soluble in acids  
soluble in most organic solvents

Additional Data:

avoid breathing the vapors and contact  
with the skin

p-CHLOROANISOLEFormula:  $\text{ClC}_6\text{H}_3\text{OCH}$ 

Formula Weight: 142.6

Melting Point:  $< -18^\circ\text{C}$ .Boiling Point:  $198^\circ\text{C}$ . (at 760 mm.)

## Solubility:

insoluble in water	soluble in ether
soluble in alcohol	soluble in chloro- form

m-CHLOROBENZALDEHYDE

Synonyms: 3-chlorobenzenecarbonal

Formula:  $\text{ClC}_6\text{H}_4\text{CHO}$ 

Formula Weight: 140.6

Melting Point:  $17$  to  $18^\circ\text{C}$ .

Boiling Point:

 $204^\circ\text{C}$ . (at 760 mm.) $213$  to  $214^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.2497(15/4)

Refractive Index: 1.5650 at  $20.2^\circ\text{C}$ .

## Solubility:

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether  
 soluble in benzene

o-CHLOROBENZALDEHYDE

Synonyms: 2-chlorobenzenecarbonal

Formula:  $\text{ClC}_6\text{H}_4\text{CHO}$ 

Formula Weight: 140.6

Melting Point:  $8$  to  $11^\circ\text{C}$ .

Boiling Point:

 $208^\circ\text{C}$ . (at 748 mm.) $209$  to  $215^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

 $1.29$  at  $8^\circ\text{C}$ . $1.252(20/4)$ Refractive Index: 1.5656 at  $21.7^\circ\text{C}$ .

## Uses:

intermediate in preparation of dyes  
 synthesis of pharmaceuticals and  
 medicines

## Solubility:

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether  
 soluble in benzene

## CHLOROBENZENE

## Synonyms:

chlorobenzol	monochloro-
chlorbenzol	benzene
	phenyl chloride

Formula:  $\text{C}_6\text{H}_5\text{Cl}$ 

## Characteristics:

inflammable  
 refractive  
 faint not unpleasant odor  
 volatile

Formula Weight: 112.6

Melting Point:

 $-45.2^\circ\text{C}$ . $-44^\circ\text{C}$ .

Boiling Point:

 $131$  to  $132.1^\circ\text{C}$ . (at 760 mm.) $130$  to  $134^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

 $1.105(25/25)$  $1.1066(20/4)$  $9.19$  lbs. per gal. at  $25^\circ\text{C}$ .

Refractive Index:

 $1.5248$  $1.5216$  at  $25^\circ\text{C}$ .

Flash Point:

 $80^\circ\text{F}$ . (closed) $95^\circ\text{F}$ . (closed)Specific Heat (gram-calories per g.  
per  $^\circ\text{C}$ .):  $0.30$  (liquid)Heat of Vaporization (gram-calories  
per g.):  $77.6$  at the boiling point

## Uses:

solvent for ethylcellulose, resins,  
 dyes and intermediates, perfumes,  
 drugs, and explosives  
 organic syntheses - phenol, aniline,  
 and picric acid

Solubility (grams per 100 ml.):

 $0.049$  (in water) $\infty$  (in alcohol)at  $30^\circ\text{C}$ . $\infty$  (in ether)

soluble in

 $\infty$  (in benzene)

chloroform

 $\infty$  (in carbon

soluble in carbon tetrachloride)  
disulfide  
miscible with most organic solvents

## Additional Data:

vapor density, 3.88  
critical temperature, 359° C.  
critical pressure, 44.6 atm.  
freezes at -35° C.  
fire point, 36° C.  
specific resistivity,  $7.8 \times 10^9$  ohms  
per cm.  
dielectric constant, 1000 cycle 5.53  
coefficient of expansion, 0.00092  
per ° C. in the range 10 to 30° C.

## 1,2-CHLOROBENZOYL CHLORIDE

Formula:  $\text{ClC}_6\text{H}_4\text{COCl}$ 

Formula Weight: 175.0

Melting Point: -4° C.

## Boiling Point:

229 to 230° C. (at 773 mm.)

227 to 239° C. (at 760 mm.)

## Uses:

intermediate in manufacture of pharmaceuticals and other chemicals

## Solubility:

decomposes in	decomposes in
water	alcohol

## 1,3-CHLOROBENZOYL CHLORIDE

Formula:  $\text{ClC}_6\text{H}_4\text{COCl}$ 

Formula Weight: 175.0

Boiling Point: 225° C. (at 760 mm.)

## Solubility:

decomposes in	decomposes in
water	alcohol

## 1,4-CHLOROBENZOYL CHLORIDE

Formula:  $\text{ClC}_6\text{H}_4\text{COCl}$ 

Formula Weight: 175.0

Melting Point: 15 to 16° C.

## Boiling Point:

220 to 222° C. (at 760 mm.)

225 to 233° C. (at 760 mm.)

Specific Gravity: 1.377

## Uses:

intermediate in manufacture of pharmaceuticals and other chemicals

## Solubility:

decomposes in	decomposes in
water	alcohol

## 1-CHLOROBUTANE

Synonyms: butyl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{Cl}$ 

Characteristics: ethereal odor

Formula Weight: 92.6

Melting Point: -123.1° C.

## Boiling Point:

78.6° C.

(at 760 mm.)

77.9° C.

(at 763 mm.)

## Specific Gravity:

0.8875(20/20)

0.86 to 0.89(20/20)7.4 lbs. per gal. at 20° C.

Refractive Index: 1.4015

Surface Tension (dynes per cm.): 23.36

## Viscosity (centipoises):

0.44 at 25° C.0.31 at 60° C.Flash Point: 15 to 20° F. (open)

Specific Heat (gram-calories per g.  
per ° C.): 0.431 (liquid) at 20° C.

Heat of Vaporization (gram-calories  
per g.): 79.77 at 76.5° C.

## Uses:

solvent for fats, greases, oils, and  
waxes  
alkylating agent for butyl compounds

## 1-CHLOROBUTANE (Cont.)

## Solubility:

0.08% by weight (of water) at 20°C.

0.066 grams per 100 ml. (in water)  
at 12.5°C. $\infty$  (in alcohol)  $\infty$  (in ether)  
soluble in acetone, benzene, gasoline,  
methanol, and ethyl acetateAdditional Data: coefficient of expansion,  
0.00080 per °C.

## 2-CHLOROBUTANE

## Synonyms:

sec-butyl chloride  
ethylmethylchloromethaneFormula:  $C_2H_5CHClCH_3$ 

Characteristics: ethereal odor

Formula Weight: 92.6

Melting Point: -131.3°C.

Boiling Point:

68°C. 67.8°C.  
(at 760 mm.) (at 767 mm.)

Specific Gravity: 0.8707(20/4)

Refractive Index: 1.3953 at 25°C.

## Solubility:

insoluble in  $\infty$  (in alcohol)  
water  $\infty$  (in chloroform)

## 3-CHLORO-2-BUTANOL

## Synonyms:

 $\beta$ ,  $\gamma$ -butylene chlorohydrinFormula:  $CH_3CHClCHOHCH_3$ 

Formula Weight: 108.6

Boiling Point:

136 to 137.5°C. (at 760 mm.)

Specific Gravity: 1.105 at 20°C.

Solubility (grams per 100 ml.):  
6.6 (in water) at 20°C.

## 1-CHLORO-2-BUTANONE

Synonyms: chloromethyl ethyl ketone

Formula:  $CH_2ClCOC_2H_5$ 

Formula Weight: 106.6

Boiling Point: 137 to 138°C. (at 760 mm.)

Specific Gravity: 1.08 at 13°C.

Solubility: insoluble in water

## 1-CHLORO-2-BUTENE

## Synonyms:

crotonyl chloride crotyl chloride

Formula:  $CH_3CH:CHCH_2Cl$ 

Formula Weight: 90.6

Boiling Point: 84°C. (at 760 mm.)

Specific Gravity: 0.934(20/4)

## Solubility:

insoluble in  $\infty$  (in alcohol)  
water  $\infty$  (in ether)

## 2-CHLORO-2-BUTENE

Formula:  $CH_3CCl:CHCH_3$ 

Formula Weight: 90.6

Boiling Point:

cis 70.4°C. trans 61.7°C.  
(at 760 mm.) (at 760 mm.)

Vapor Pressure (mm. Hg):

143.4 at 20°C.

Specific Gravity:

0.913(20/4)  
7.62 lbs. per gal. at 20°C.

Flash Point:

-14°F. (open) -3°F. (closed)

Heat of Vaporization (gram-calories  
per g.): 79.9Solubility (grams per 100 g. of solution):  
0.05 (in water)

**4-CHLORO-1,2-tert-BUTYLPHENOL**Formula:  $(\text{CH}_3)_3\text{CC}_6\text{H}_3(\text{OH})\text{Cl}$ 

Formula Weight: 184.7

Melting Point:  $< -20^\circ\text{C}$ .Boiling Point:  $234$  to  $251^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.112(25/25)

Solubility: insoluble in water

 $\infty$  (in alcohol)  $\infty$  (in benzene) $\infty$  (in ether)  $\infty$  (in methyl $\infty$  (in chloroform) alcohol) **$\alpha$ ,  $\text{dl}$ -CHLOROBUTYRIC ACID**Formula:  $\text{C}_2\text{H}_5\text{CHClCOOH}$ 

Characteristics: oily

Formula Weight: 122.6

Boiling Point:  $101.3^\circ\text{C}$ . (at 15 mm.)

Solubility: soluble in hot water

 $\infty$  (in alcohol)  $\infty$  (in ether) **$\beta$ ,  $\text{dl}$ -CHLOROBUTYRIC ACID**Formula:  $\text{CH}_3\text{CHClCH}_2\text{COOH}$ 

Formula Weight: 122.6

Melting Point:  $16.0$  to  $16.5^\circ\text{C}$ .Boiling Point:  $109$  to  $110^\circ\text{C}$ . (at 17 mm.)

Specific Gravity: 1.186(20/4)

Solubility:

soluble in alcohol soluble in ether

 **$\gamma$ -CHLOROBUTYRIC ACID**Formula:  $\text{CH}_2\text{ClCH}_2\text{CH}_2\text{COOH}$ 

Formula Weight: 122.6

Melting Point:  $16^\circ\text{C}$ .

Boiling Point:

 $116^\circ\text{C}$ . (at 31 mm.)

slight decomposition

Specific Gravity: 1.250

Solubility:

soluble in alcohol soluble in ether

 **$\gamma$ -CHLOROBUTYRONITRILE**Formula:  $\text{CH}_2\text{ClCH}_2\text{CH}_2\text{CN}$ 

Formula Weight: 103.6

Boiling Point:  $195$  to  $197^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 1.162 at  $10^\circ\text{C}$ .

Solubility: insoluble in water

soluble in alcohol soluble in ether

**CHLOROCOSANE**

Synonyms:

a grade of chlorinated paraffin

Formula:

contains approximately 30 to 40% of chlorine

Characteristics:

pale yellow to thick

amber oily

Specific Gravity: 1.00 to 1.07 at  $25^\circ\text{C}$ .

Uses: solvent for dichloroamine

**CHLOROCYCLOHEXANE**

Synonyms: cyclohexyl chloride

Formula:  $\text{C}_6\text{H}_{11}\text{Cl}$ 

Characteristics: suffocating odor

Formula Weight: 118.6

Melting Point:  $-43.9^\circ\text{C}$ .Boiling Point:  $142^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.997(18/4) 1.0161(0/0)

1.0000(20/4)

Refractive Index: 1.4626

Solubility:

insoluble in water  $\infty$  (in ether) $\infty$  (in alcohol)  $\infty$  (in benzene) **$i$ '-CHLOROCYMENE**

Synonyms: cuminyl chloride

Formula:  $\text{C}_3\text{H}_7\text{C}_6\text{H}_4\text{CH}_2\text{Cl}$ 

Formula Weight: 168.7

Boiling Point:  $225$  to  $229^\circ\text{C}$ . (at 760 mm.)

## 1-CHLORODECANE

Synonyms: decyl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{Cl}$

Formula Weight: 176.7

Boiling Point: 180 to 190° C. (at 720 mm.)

Specific Gravity: 0.887 to 200° C.

Solubility: insoluble in water

2-CHLORO-4,6-di-tert-AMYLPHENOL

Formula:  $(\text{C}_5\text{H}_{11})_2\text{C}_6\text{H}_2\text{ClOH}$

Characteristics:

light straw color      odorless

Formula Weight: 268.8

Melting Point: -500° C.

Boiling Point: 160 to 179° C. (at 22 mm.)

Specific Gravity: 1.01(20/20)

Refractive Index: 1.515

Flash Point: 2500° F. (closed)

## 1-CHLORO-1,1-DIBROMOETHANE

Formula:  $\text{CH}_3\text{CClBr}_2$

Formula Weight: 222.3

Boiling Point: 123 to 124° C. (at 753 mm.)

Specific Gravity: 2.134 at 16° C.

## 1-CHLORO-1,2-DIBROMOETHANE

Formula:  $\text{CH}_2\text{BrCHClBr}$

Formula Weight: 222.3

Boiling Point:

162.5 to 163° C. (at 760 mm.)

Specific Gravity: 2.268 at 16° C.

## CHLORODIBROMOMETHANE

Formula:  $\text{CHClBr}_2$

Formula Weight: 208.3

Melting Point: -22±

Boiling Point:

1200° C. (at 730 mm.) slight  
decomposition

Specific Gravity: 2.445 at 15° C.

## 1-CHLORO-2,2-DIFLUOROETHANE

Formula:  $\text{CH}_2\text{ClCHF}_2$

Formula Weight: 100.5

Boiling Point: 36° C. (at 760 mm.)

Specific Gravity: <1

## CHLORODIIODOMETHANE

Formula:  $\text{CHCl}_2$

Formula Weight: 302.3

Melting Point: -4° C.

Boiling Point: 200±° C. decomposes

Specific Gravity: 3.170 at 0° C.

## 1-CHLORO-2,3-DIMETHYLBUTANE

Synonyms: hexyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_2\text{Cl})\text{CH}_3$

Formula Weight: 120.6

Boiling Point: 122° C. (at 760 mm.)

Specific Gravity: 0.887 at 22° C.

## 2-CHLORO-2,3-DIMETHYLBUTANE

Synonyms: hexyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCCl}(\text{CH}_3)_2$

Formula Weight: 120.6

Melting Point: -10.4° C.

Boiling Point: 112° C. (at 760 mm.)

Specific Gravity: 0.878 at 19° C.

## 3-CHLORO-2,3-DIMETHYLPENTANE

Synonyms: heptyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCCl}(\text{CH}_3)\text{C}_2\text{H}_5$

Formula Weight: 134.7

Melting Point:  $< -15^{\circ}\text{C}$ .

Boiling Point:  $135$  to  $138^{\circ}\text{C}$ . (at  $757$  mm.)

Specific Gravity:  $0.884$  at  $22^{\circ}\text{C}$ .

Solubility: insoluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

#### x-CHLORODIPHENYL ETHER

Formula:  $\text{C}_6\text{H}_5\text{OC}_6\text{H}_4\text{Cl}$

Formula Weight:  $204.6$

Melting Point:  $-27.5^{\circ}\text{C}$ .

Boiling Point:  $140$  to  $160^{\circ}\text{C}$ . (at  $8$  mm.)

Specific Gravity:  $1.18$  to  $1.20(25/25)$

Viscosity (centipoises):  
 $5$  at  $25^{\circ}\text{C}$ .  $2.2$  at  $60^{\circ}\text{C}$ .

Flash Point:  $259^{\circ}\text{F}$ . (closed)

Solubility:  
 insoluble in water  
 soluble in methyl alcohol  
 $\infty$  (in ether)  
 soluble in carbon tetrachloride  
 $\infty$  (in acetone)  $\infty$  (in benzene)

#### 1-CHLORODODECANE

Synonyms:  
 dodecyl chloride lauryl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{Cl}$

Formula Weight:  $204.8$

Boiling Point:  $128$  to  $130^{\circ}\text{C}$ . (at  $11$  mm.)

Solubility:  
 insoluble in water soluble in ether

#### CHLOROETHANE

Synonyms:  
 ethyl chloride monochloroethane  
 "Kelene" muriatic ether  
 hydrochloric ether

Formula:  $\text{C}_2\text{H}_5\text{Cl}$

Characteristics:  
 characteristic ether-like odor  
 volatile

Formula Weight:  $64.5$

Melting Point:  
 $-138.7^{\circ}\text{C}$ .  $-139^{\circ}\text{C}$ .  
 $-140.9^{\circ}\text{C}$ .

Boiling Point:  
 $12$  to  $13^{\circ}\text{C}$ .  $12.3^{\circ}\text{C}$ .  
 (at  $760$  mm.) (at  $760$  mm.)

Specific Gravity:  
 $0.917(0/0)$   $0.9214(0/4)$   
 $7.70$  lbs. per gal. at  $0^{\circ}\text{C}$ .

Inflammability Range (volume per cent  
 in air):  
 $3.6$  (lower limit)  $14.8$  (upper limit)

Flash Point:  
 $-45^{\circ}\text{F}$ . (open)  $-58^{\circ}\text{F}$ . (closed)

Specific Heat (gram-calories per g.  
 per  $^{\circ}\text{C}$ .):  $0.37$  (liquid) at  $0^{\circ}\text{C}$ .

Heat of Vaporization:  
 $389$  joules per g. at  $4.7^{\circ}\text{C}$ .  
 $387$  joules per g. at  $25^{\circ}\text{C}$ .  
 $92.5$  gram-calories per g. at the  
 boiling point

Heat of Combustion (kilogram-calories  
 per mole):  $316.7$  (gas)

Uses:  
 alkylation of organic compounds  
 local anesthetic refrigeration  
 insecticides  
 solvent for fats, oils, resins, waxes,  
 dyes, pharmaceuticals, and various  
 chemicals  
 analytical reagent

Solubility (grams per  $100$  ml.):  
 $0.6$  (in water)  
 $0.754$  (in water) at  $20^{\circ}\text{C}$ .  
 $48.3$  (in alcohol) at  $21^{\circ}\text{C}$ .  
 $\infty$  (in ether)  
 $\infty$  (in carbon tetrachloride)  
 miscible with most usual organic  
 solvents

Additional Data:  
 should be stored cool and away from  
 light  
 burns with a smoky greenish flame  
 critical temperature,  $187.2^{\circ}\text{C}$ .  
 critical pressure,  $52$  atm.

## CHLOROETHANE (Cont.)

thermal conductivity (gas), 0.837  
at 0°C.  
dielectric constant, 6.29 at 170°C.  
vapor density, 2.22

## 2-CHLORO-1-ETHANOL

## Synonyms:

2-chloroethanol  
2 or  $\beta$ -chloroethyl alcohol  
ethylene chlorohydrin  
glycol chlorohydrin

Formula:  $\text{CH}_2\text{ClCH}_2\text{OH}$

Characteristics: faint, ethereal odor

Formula Weight: 80.5

Melting Point: -69 to -67°C.

Boiling Point:

128.8 to 130°C. (at 760 mm.)

Specific Gravity:

1.213(20/4)                      1.2045(20/20)  
10.0 lbs. per gal. at 20°C.

Refractive Index: 1.4419

Flash Point: 140°F. (open)

## Uses:

organic syntheses      solvent for  
insecticides              cellulose acetate

Solubility (grams per 100 ml.):

$\infty$  (of water)               $\infty$  (in water)  
soluble in alcohol  
2.3 (in ether) at 15°C.  
soluble in organic liquids

## Additional Data:

the azeotropic mixture with water con-  
tains 57.7% water by weight, boils at  
97.8°C. and has a specific gravity of  
1.0934(20/20)  
vapor density, 2.78

1-(2-CHLOROETHOXY)-  
2-PHENOXYETHANE

## Synonyms:

phenoxy  $\beta'$ -chloroethyl ether

Formula:  $\text{C}_6\text{H}_5\text{O}(\text{CH}_2)_2\text{OCH}_2\text{CH}_2\text{Cl}$

Characteristics: pale yellow

Formula Weight: 200.7

Boiling Point: 138 to 143°C. (at 8 mm.)

Solubility:

insoluble in                      soluble in alcohol  
water                              soluble in ether

## 2-(2-CHLOROETHOXY)ETHANOL

## Synonyms:

chlorohydroxy diethyl ether  
diglycol chlorohydrin

Formula:  $\text{CH}_2\text{ClCH}_2\text{OCH}_2\text{CH}_2\text{OH}$

Formula Weight: 124.6

Boiling Point: 196.8°C. (at 760 mm.)

Specific Gravity:

1.170(20/20)  
9.7 lbs. per gal. at 20°C.

Flash Point: 225°F. (open)

## Uses:

medical stimulant  
chemical intermediate  
syntheses of dyes, resins, insecticides,  
and pharmaceuticals

Solubility:

$\infty$  (of water)                       $\infty$  (in water)

 $\beta$ -CHLOROETHYL ACETATE

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{Cl}$

Formula Weight: 122.6

Melting Point: < -20°C.

Boiling Point: 145°C. (at 760 mm.)

Specific Gravity:

1.152(25/25)                      1.178

Refractive Index: 1.4247

Flash Point:

145°F. (open)                      129°F. (closed)

## Uses:

solvent for cellulose acetate, nitro-  
cellulose, and resins

Solubility (grams per 100 ml.):

3 (in water)  $\infty$  (in alcohol)  
at 25° C.  $\infty$  (in ether)  
miscible with most common organic  
solvents

Additional Data: fire point, 150° C.

### $\beta$ -CHLOROETHYLBENZENE

Synonyms:  $\beta$ -phenyl ethyl chloride

Formula:  $C_6H_5CH_2CH_2Cl$

Formula Weight: 140.6

Boiling Point:

190 to 200° C. (at 760 mm.)  
slight decomposition

Specific Gravity: 1.069(25/4)

### 2-CHLOROETHYLBENZENE

Synonyms:

o-chloroethylbenzene  
1-chloro-2-ethylbenzene

Formula:  $C_2H_5C_6H_4Cl$

Formula Weight: 140.6

Melting Point:

< -81° C. -80.2° C.

Boiling Point:

179.2° C. 177.6° C.  
(at 760 mm.) (at 760 mm.)

Specific Gravity: 1.055(25/25)

Solubility:

insoluble in  $\infty$  (in alcohol)  
water  $\infty$  (in ether)

### 3-CHLOROETHYLBENZENE

Synonyms:

m-chloroethylbenzene  
"Alkazene 20"  
1-chloro-3-ethylbenzene

Formula:  $C_2H_5C_6H_4Cl$

Formula Weight: 140.6

Melting Point: -53.3° C.

Boiling Point: 183.0° C. (at 760 mm.)

Specific Gravity: 1.045(25/25)

Solubility:

insoluble in water  $\infty$  (in benzene)  
 $\infty$  (in alcohol)  $\infty$  (in acetone)  
 $\infty$  (in ether)  $\infty$  (in carbon  
tetrachloride)

### 4-CHLOROETHYLBENZENE

Synonyms:

p-chloroethylbenzene  
"Alkazene 21"  
1-chloro-4-ethylbenzene

Formula:  $C_2H_5C_6H_4Cl$

Characteristics:

mild characteristic odor

Formula Weight: 140.6

Melting Point:

-62° C. -70° C.  
-62.6° C.

Boiling Point:

184.6° C. (at 760 mm.)  
181.2 to 183.8° C. (at 760 mm.)

Specific Gravity:

1.044(25/25) 1.050(25/25)

Viscosity (centipoises):

1.0 at 25° C. 0.6 at 60° C.

Flash Point: 147° F. (closed)

Solubility:

insoluble in water  $\infty$  (in carbon  
 $\infty$  (in alcohol) tetrachloride)  
 $\infty$  (in ether)  $\infty$  (in methyl  
alcohol)

### CHLOROETHYL-2-CHLORO- 4-tert-BUTYLPHENYL ETHER

Formula:  $(CH_3)_3CC_6H_3ClOCH_2CH_2Cl$

Formula Weight: 247.2

Melting Point: < -20° C.

Boiling Point: 176 to 180° C. (at 18 mm.)

Specific Gravity: 1.149(25/25)

## CHLOROETHYL-2-CHLORO-4-BUTYLPHENYL ETHER (Cont.)

## Solubility:

insoluble in water	$\infty$ (in carbon tetrachloride)
$\infty$ (in alcohol)	$\infty$ (in benzene)
$\infty$ (in ether)	$\infty$ (in acetone)

 $\beta$ -CHLOROETHYL CHLOROFORMATE

## Synonyms:

 $\beta$ -chloroethyl chlorocarbonateFormula:  $\text{ClCOOCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 143.0

## Boiling Point:

150 to 160° C. (at 760 mm.)

152.5° C. (at 752 mm.)

Specific Gravity: 1.3825 at 20° C.

Uses: organic syntheses

## Solubility:

insoluble and decomposes in water  
 very soluble in alcohol  
 very soluble in ether  
 decomposes in alkalis

Additional Data: very irritating

 $\beta$ -CHLOROETHYL ETHYL ETHER

## Synonyms:

 $\beta$ -chlorodiethyl ether

1-chloro-2-ethoxyethane

Formula:  $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 108.6

Boiling Point: 107 to 108° C. (at 760 mm.)

## Specific Gravity:

0.984(20/4)

1.0572(0/4)

## 1-CHLORO-2-ETHYLHEXANE

Synonyms: ethylhexyl chloride

Formula:  $\text{C}_4\text{H}_9\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{Cl}$ 

Formula Weight: 148.7

Boiling Point: 173 to 175° C. (at 760 mm.)

## Specific Gravity:

0.867(20/20)

7.2 lbs. per gal. at 20° C.

Refractive Index: 1.4310

## Uses:

syntheses of cellulose compounds,  
 dyes, drugs, and textile assistants

Solubility: insoluble in water

 $\beta$ -CHLOROETHYL METHYL ETHERSynonyms: methyl  $\beta$ -chloroethyl etherFormula:  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 94.5

Boiling Point: 89 to 90° C. (at 760 mm.)

Specific Gravity: 1.046(20/4)

## Uses:

solvent for ethyl cellulose  
 solvent mixture for celluloid, and  
 nitrocellulose

Solubility (grams per 100 ml.):

1.7 (in water)

 $\infty$  (in alcohol) $\infty$  (in ether) $\beta$ -CHLOROETHYL  
p-TOLUENESULFONATEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SO}_2\text{OCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 234.7

Melting Point: 19 to 20° C.

## 1-CHLORO-2-FLUOROBENZENE

Synonyms: o-chlorofluorobenzene

Formula:  $\text{FC}_6\text{H}_4\text{Cl}$ 

Formula Weight: 130.6

Melting Point: -42.5

Boiling Point: 138° C. (at 774 mm.)

## 1-CHLORO-3-FLUOROBENZENE

Synonyms: m-chlorofluorobenzene

Formula:  $\text{FC}_6\text{H}_4\text{Cl}$

Formula Weight: 130.6

Boiling Point: 123 to 125° C. (at 760 mm.)

Solubility: insoluble in water  
 very soluble in alcohol      very soluble in ether

### 1-CHLORO-4-FLUOROBENZENE

Synonyms: p-chlorofluorobenzene

Formula:  $\text{FC}_6\text{H}_4\text{Cl}$

Formula Weight: 130.6

Melting Point: -27.7 to -26.9° C.

Boiling Point:  
 130.1° C. (at 760 mm.)  
 130° C. (at 756 mm.)

Specific Gravity: 1.226(20.5/4)

Refractive Index: 1.4990 at 15° C.

### CHLOROFORM

Synonyms:

formyl trichloride	methyl trichloride
methenyl	trichloromethane
trichloride	

Formula:  $\text{CHCl}_3$

Characteristics:

highly refractive	characteristic
very volatile	odor
sweet tasting	nonflammable

Formula Weight: 119.4

Melting Point: -63.5° C.

Boiling Point: 61.2° C. (at 760 mm.)

Specific Gravity:

1.489 at 20° C.	1.4985(15/4)
1.484(20/20)	1.489(20/4)
1.477(25/25)	
12.29 lbs. per gal. at 25° C.	

Refractive Index:

1.4464 at 18° C.	1.4476
1.4422	
1.001436 (vapor) at 0° C.	

Surface Tension (dynes per cm.):

27.14 (air) at 20° C.  
 26.2 (nitrogen) at 25° C.

Viscosity (centipoises):

0.835 at -13° C.	0.571 at 20° C.
0.706 at 0° C.	0.474 at 40° C.

Flash Point: none open or closed

Specific Heat (gram-calories per g. per ° C.):

0.234 (liquid) at 20° C.  
 0.142 (vapor) (Cp - 1 atm.)  
 at 61.2° C.

Heat of Vaporization (gram-calories per g.): 59.0 at the boiling point

Heat of Combustion (kilogram-calories per g. mol.): 89.2 (liquid)

Uses:

solvent for acetic acid, acetic anhydride, alkaloids, celanese yarns, cellulose esters, dimethylhydrocellulose, dry cleaning industries, extracting essential and fatty oils, fats, gutta percha, methyl cellulose, photographic industries, and resins	anesthetic	organic syntheses
	analyses	pharmaceuticals
	drugs	preservatives
	dry cleaning	plastics
	dyes	salves
	insecticides	spot remover
	liniments	vermicides

Solubility:

0.097 g. per 100 g.  $\text{CHCl}_3$  (of water) at 25° C.  
 0.82 g. per 100 ml. (in water) at 20° C.  
 1.0 g. per 100 ml. (in water) at 15° C.  
 $\infty$  (in alcohol)       $\infty$  (in ether)  
 soluble in oils, carbon tetrachloride, carbon disulfide, acetone, and benzene  
 miscible with most organic solvents

Additional Data:

fire point, none  
 specific resistivity,  $4.0 \times 10^9$  ohms per cm.

keep cool and protect from light  
 critical temperature, 262.9° C.

critical pressure, 53.8 atm.

weight of pure vapor, 5330 mg. per l.  
 steam distillation point (1 atm.)  
 56.00 F.

## CHLOROFORM (Cont.)

solvent to water ratio by weight,  
34.1:1  
thermal conductivity, liquid (20°C.)  
0.0751, vapor (b. p.) 0.00455 Btu./hr.  
(sq. ft.) (F./ft.)  
coefficient of expansion,  
0.00129 per °C. at 0 - 40°C.  
vapor density, 4.36 g./l.  
diffusivity in air (25°C., 1 atm.),  
0.079 sq. cm./sec.  
evaporation rate (ether = 100), 56  
dielectric constant (liquid),  
4.785 at 20°C. 4.90 at 25°C.  
(vapor), 1.00462  
heat of formation, 31.2 kilogram-  
calories per mole (liquid)  
electrical conductivity, <10<sup>-10</sup> mhos  
per cm. at 25°C.

## 1-CHLOROHEXANE

Synonyms: n-hexyl chloride  
Formula: CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>CH<sub>2</sub>Cl  
Characteristics: sweet odor  
Formula Weight: 120.6  
Melting Point:  
-83°C.  
solidifies at <-60°C.  
Boiling Point:  
132.9°C. (at 756 mm.)  
132.4°C. (at 760 mm.)  
133 to 135°C. (at 760 mm.)  
Specific Gravity:  
0.8719(20/4) 0.877(20/20)  
Refractive Index: 1.4194  
Viscosity (centipoises): 0.79 at 25°C.  
Flash Point: 95°F. (closed)  
Solubility:  
insoluble in water  
soluble in methyl alcohol, ether,  
benzene, acetone, gasoline, and  
ethyl acetate

## Additional Data:

coefficient of expansion,  
0.00109 per °C.

## 2-CHLOROHEXANE

Synonyms: hexyl chloride  
Formula: CH<sub>3</sub>(CH<sub>2</sub>)<sub>3</sub>CHClCH<sub>3</sub>  
Formula Weight: 120.6  
Boiling Point:  
122.5°C. (at 754 mm.)  
123 to 126°C. (at 760 mm.)  
Specific Gravity:  
0.869(21/4) 0.876(14/4)  
Refractive Index: 1.4142 at 22°C.

γ-CHLORO-  
β-HYDROXYBUTYRONITRILE

Synonyms:  
β-hydroxy-γ-chlorobutyronitrile (dl)  
Formula: CH<sub>2</sub>ClCHOHCH<sub>2</sub>CN  
Characteristics: yellow  
Formula Weight: 119.6  
Boiling Point:  
250°C. (at 760 mm.) decomposes  
Solubility:  
soluble in water, alcohol, and ether

m-CHLOROIODOBENZENE

Formula: ClC<sub>6</sub>H<sub>4</sub>I  
Characteristics: oily  
Formula Weight: 238.5  
Boiling Point: 230°C. (at 760 mm.)

o-CHLOROIODOBENZENE

Formula: ClC<sub>6</sub>H<sub>4</sub>I  
Characteristics: yellow  
Formula Weight: 238.5  
Melting Point: 0.7°C.  
Boiling Point: 234 to 235°C. (at 760 mm.)  
Specific Gravity: 1.952(25/4)

## 1,1-CHLOROIODOETHANE

Formula:  $\text{CH}_3\text{CHClI}$ 

Formula Weight: 190.4

Boiling Point: 117 to 119°C. (at 760 mm.)

Specific Gravity: 2.054 at 19°C.

## 2,1-CHLOROIODOETHANE

Formula:  $\text{CH}_2\text{ClCH}_2\text{I}$ 

Formula Weight: 190.4

Melting Point: -15.6°C.

Boiling Point: 140.1°C. (at 760 mm.)

Specific Gravity: 2.134(15.3/0)

## CHLOROIODOMETHANE

Synonyms: methylene chloriodide

Formula:  $\text{ClCH}_2\text{I}$ 

Characteristics: oily

Formula Weight: 176.4

Boiling Point: 109°C. (at 760 mm.)

Specific Gravity: 2.49 at 20°C.

 $\beta$ -CHLOROISOPROPYL ACETATEFormula:  $\text{CH}_3\text{COOCH}(\text{CH}_3)\text{CH}_2\text{Cl}$ 

Formula Weight: 136.6

Boiling Point: 149 to 150°C. (at 760 mm.)

 $\alpha$ -CHLOROISOPROPYLBENZENE

Synonyms: "Alkazene 60"

Formula:  $\text{C}_6\text{H}_4\text{ClCH}(\text{CH}_3)_2$ 

Characteristics: characteristic odor

Formula Weight: 154.1

Melting Point: &lt; -20°C.

Boiling Point:

191.3 to 193.2°C. (at 760 mm.)

Specific Gravity: 1.029(25/25)

Viscosity (centipoises):

1.2 at 25°C.

0.7 at 60°C.

Solubility:

insoluble in water

 $\infty$  (in ether) $\infty$  (in methyl alcohol) $\infty$  (in carbon tetrachloride)

## 1-CHLORO-2-METHYLBUTANE

Synonyms:

prim-act-amyl chloride

amyl chloride

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$ 

Formula Weight: 106.6

Boiling Point: 97 to 99°C. (at 760 mm.)

Specific Gravity: 0.881(18/4)

Solubility:

insoluble in  
watersoluble in alcohol  
soluble in ether

## 1-CHLORO-3-METHYLBUTANE

Synonyms:

4-chloro-2-methyl- isoamyl chloride  
butane amyl chlorideFormula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 106.6

Boiling Point: 98.9°C. (at 760 mm.)

Specific Gravity: 0.893(20/4)

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## 2-CHLORO-2-METHYLBUTANE

Synonyms:

tert-amyl chloride amyl chloride

Formula:  $\text{CH}_3\text{CH}_2\text{CCl}(\text{CH}_3)\text{CH}_3$ 

Formula Weight: 106.6

Melting Point: -73°C.

Boiling Point: 86°C. (at 760 mm.)

## 2-CHLORO-2-METHYLBUTANE (Cont.)

Specific Gravity: 0.871(20/4)

Refractive Index: 1.407 at 18°C.

## Solubility:

insoluble in	soluble in alcohol
water	soluble in ether

## 3-CHLORO-2-METHYLBUTANE

## Synonyms:

<u>sec</u> -isoamyl chloride	amyl chloride
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Formula:  $(\text{CH}_3)_2\text{CHCHClCH}_3$ 

Formula Weight: 106.6

Boiling Point: 91°C. (at 753 mm.)

Specific Gravity: 0.883 at 0°C.

## Solubility:

insoluble in	soluble in alcohol
water	soluble in ether

## CHLOROMETHYL CHLOROFORMATE

Formula:  $\text{ClCOOCH}_2\text{Cl}$ 

## Characteristics:

mobile liquid	penetrating odor
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## Boiling Point:

106.5 to 107°C. (at 760 mm.)Vapor Pressure (mm. Hg): 5.6 at 20°C.Specific Gravity: 1.465 at 15°C.

## Solubility:

decomposes in water
decomposes in alkali

## Additional Data:

highly irritating	vapor density, <u>4.5</u>
soluble in most organic solvents	

## CHLOROMETHYL ETHER

Formula:  $\text{ClCH}_2\text{OCH}_3$ 

Formula Weight: 80.5

Melting Point: -103.5°C.

Boiling Point: 59.5°C. (at 759 mm.)

Specific Gravity: 1.070(20/4)

## Solubility:

decomposes in water
decomposes in hot alcohol

## 2-(CHLOROMETHYL)FURAN

Synonyms: d-furfuryl chlorideFormula:  $\text{C}_4\text{H}_3\text{OCH}_2\text{Cl}$ 

Formula Weight: 116.6

Boiling Point: 49°C. (at 26 mm.)

Specific Gravity: 1.1783(20/4)

Refractive Index: 1.4941

## Solubility:

insoluble in	soluble in alcohol
water	soluble in ether

## 4-CHLORO-7-METHYLBINDAN

## Synonyms:

methyl-4-chlorohydrindene (7)

Formula:  $\text{CH}_3\text{C}_6\text{H}_2\text{Cl}(\text{CH}_2)_3$ 

Formula Weight: 166.7

Characteristics: yellow.

Boiling Point: 111 to 114°C. (at 10 mm.)

## 1-CHLORO-2-METHYLPROPANE

Synonyms: isobutyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{Cl}$ 

Formula Weight: 92.6

Melting Point: -131.2°C.

Boiling Point: 68.9°C. (at 760 mm.)

Specific Gravity: 0.884 at 15°C.

Refractive Index: 1.3960

## Solubility:

insoluble in water	$\infty$ (in ether)
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## CHLOROMETHYL CHLOROSULFONATE

Formula:  $\text{ClCH}_2\text{OCISO}_2$ Boiling Point: 49 to 50°C. (at 14 mm.)Specific Gravity: 1.63

Uses: organic syntheses

Additional Data: highly irritating

## 2-CHLORO-2-METHYLPROPANE

## Synonyms:

tert-butyl chloride  
trimethylchloromethane

Formula:  $(\text{CH}_3)_3\text{CCl}$ 

Formula Weight: 92.6

Melting Point:  $-28.5$  to  $-26.5^\circ\text{C}$ .Boiling Point:  $51$  to  $52^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.847(15/4)

Refractive Index: 1.3869 at  $18^\circ\text{C}$ .

## Solubility:

insoluble in	$\infty$ (in alcohol)
water	$\infty$ (in ether)

3-CHLORO-2-METHYL-  
1,2-PROPANEDIOL

## Synonyms:

methylglycerine  
chlorohydrin ( $\beta'$ , mono)

Formula:  $\text{CH}_2\text{ClC}(\text{CH}_3)\text{OHCH}_2\text{OH}$ 

Formula Weight: 124.6

Boiling Point:  $95$  to  $96^\circ\text{C}$ . (at 7 mm.)

Specific Gravity: 1.273(20/4)

Solubility:  $\infty$  (in water)

## 1-CHLORO-2-METHYL-2-PROPANOL

Synonyms: isobutylene  $\alpha$ -chlorohydrinFormula:  $(\text{CH}_3)_2\text{COHCH}_2\text{Cl}$ 

Formula Weight: 108.6

Melting Point:  $-20^\circ\text{C}$ .Boiling Point:  $127$  to  $129^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.061(20/4)

## Solubility:

slightly soluble in water  
soluble in hydrochloric acid

## 2-CHLORO-2-METHYL-1-PROPANOL

Synonyms: isobutylene  $\beta$ -chlorohydrinFormula:  $(\text{CH}_3)_2\text{CClCH}_2\text{OH}$ 

Formula Weight: 108.6

## Boiling Point:

$132$  to  $133^\circ\text{C}$ . (at 760 mm.)  
slight decomposition

## Solubility:

soluble in hydrochloric acid

## 3-CHLORO-2-METHYLPROPENE

## Synonyms:

$\gamma$ -chloroisobutylene  
isobutenyl chloride  
 $\beta$ -methallyl chloride

Formula:  $\text{CH}_2\text{C}(\text{CH}_3)\text{CH}_2\text{Cl}$ 

Characteristics: toxic

Formula Weight: 90.6

Melting Point:  $< -80^\circ\text{C}$ .

## Boiling Point:

$72.17^\circ\text{C}$ . (at 760 mm.)  
 $69$  to  $77^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.9257(20/4)  
7.72 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4276

Inflammability Range (volume per cent  
in air):

3.2 (lower limit)      8.1 (upper limit)

## Flash Point:

 $14^\circ\text{F}$ . (open)       $11^\circ\text{F}$ . (closed)Heat of Vaporization (gram-calories  
per g.): 82.8

Uses: fumigant

Solubility (grams per 100 ml.):

$< 0.1$  (of water) at  $20^\circ\text{C}$ .  
0.1 (in water)

## Additional Data:

coefficient of expansion,  
0.000706 per  $^\circ\text{F}$ .

## 1-CHLORONAPHTHALENE

## Synonyms:

$\alpha$ -chloronaphthalene  
 $\alpha$ -naphthyl chloride

## 1-CHLORONAPHTHALENE (Cont.)

Formula:  $C_{10}H_7Cl$ 

Formula Weight: 162.6

Melting Point:  $-20^{\circ}C$ .

Boiling Point:

259.3 $^{\circ}C$ . (at 760 mm.)263 $^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.1938(20/4)

Refractive Index: 1.6332

Solubility:

insoluble in water	$\infty$ (in carbon
soluble in alcohol	disulfide)
$\infty$ (in ether)	$\infty$ (in benzene)

## CHLORONAPHTHALENE OILS

Characteristics:

thinly fluid                  nearly odorless

Melting Point: solidifies at  $-36^{\circ}C$ .Boiling Point: 249 to 288 $^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.20 to 1.25 at 20 $^{\circ}C$ .Flash Point: 350 $^{\circ}F$ . (closed)Specific Heat (gram-calories per g.  
per  $^{\circ}C$ .):0.282 at 30 to 60 $^{\circ}C$ . (liquid)

Uses:

carbon remover and softener  
 fireproofing agent  
 heat transfer medium  
 solvent for dyes, oils, rubber, gums,  
 resins, and waxes

Solubility:

soluble in carbon tetrachloride  
 soluble in benzene

Additional Data:

soluble in nearly all organic solvents

## 1-CHLORO-1-NITROETHANE

Formula:  $CH_3CHClNO_2$ 

Formula Weight: 109.5

Boiling Point: 124 to 125 $^{\circ}C$ . (at 758 mm.)

Specific Gravity:

1.258(20/20)10.47 lbs. per gal. at 20 $^{\circ}C$ .Refractive Index: 1.423Flash Point: 133 $^{\circ}F$ . (open)

Uses:

solvent for adhesives  
 anti-gelling agent for accelerated  
 rubber cements  
 insecticides  
 synthesis of diamines and other com-  
 plex organic compounds

Solubility (grams per 100 ml.):

< 0.5 (of water)	soluble in alkalis
< 0.4 (in water)	vapor density, 3.7

## 1-CHLORO-2-NITROETHANE

Formula:  $CH_2ClCH_2NO_2$ 

Formula Weight: 109.5

Boiling Point: 173 to 174 $^{\circ}C$ . (at 760 mm.)Specific Gravity: 1.4057 at 0 $^{\circ}C$ .

Solubility:

insoluble in water  
 decomposes in hydrochloric acid

## 1-CHLORO-1-NITROPROPANE

Formula:  $C_2H_5CHClNO_2$ 

Formula Weight: 123.5

Boiling Point:

140 to 143 $^{\circ}C$ . (at 760 mm.)139.5 to 143.3 $^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.209(20/20)10.06 lbs. per gal. at 20 $^{\circ}C$ .Refractive Index: 1.430Flash Point: 144 $^{\circ}F$ . (open)

Uses:

solvent for adhesives  
 anti-gelling agent for accelerated  
 rubber cements  
 insecticides  
 synthesis of diamines and other com-  
 plex organic compounds

Solubility (grams per 100 ml.):

<0.4 (of water)

<0.08 (in water) at 20°C.

Additional Data: vapor density, 4.26

### 1-CHLORO-2-NITROPROPANE

Formula:  $C_2H_5CHClNO_2$

Formula Weight: 123.5

Boiling Point:

134°C. (at 760 mm.)

slight decomposition

Specific Gravity: 1.193(20/20)

Refractive Index: 1.6332

Solubility (grams per 100 ml.):

<0.05 (in water) at 20°C.

soluble in alcohol      insoluble in

soluble in ether          alkalis

Additional Data:

explodes when heated rapidly

### 2-CHLORO-2-NITROPROPANE

Formula:  $(CH_3)_2C(NO_2)Cl$

Formula Weight: 123.5

Boiling Point:

129.0 to 132.3°C. (at 760 mm.)

Specific Gravity:

1.193(20/20)

9.93 lbs. per gal. at 20°C.

Refractive Index: 1.425

Flash Point: 135°F. (open)

Uses:

solvent for adhesives

anti-gelling agent for accelerated  
rubber cements

insecticides

synthesis of diamines and other com-  
plex organic compounds

Solubility (grams per 100 ml.):

<0.5 (of water)      <0.5 (in water)

Additional Data: vapor density, 4.26

### 2-CHLORONONANE

Synonyms: nonyl chloride (2)

Formula:  $C_7H_{15}CHClCH_3$

Formula Weight: 162.7

Boiling Point: 190°C. (at 764 mm.)

Specific Gravity: 0.856 at 20°C.

### 1-CHLOROOCCTANE

Synonyms: octyl chloride

Formula:  $CH_3(CH_2)_6CH_2Cl$

Formula Weight: 148.7

Boiling Point:

182.5 to 184.6°C. (at 760 mm.)

Specific Gravity:

0.892(0/4)

0.8745(20/4)

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

### 2-CHLOROOCCTANE

Synonyms: sec-octyl chloride

Formula:  $CH_3(CH_2)_5CHClCH_3$

Formula Weight: 148.7

Boiling Point: 171 to 173°C. (at 760 mm.)

Specific Gravity: 0.871(15/4)

Solubility:

insoluble in

∞ (in alcohol)

'water

∞ (in ether)

### 1-CHLOROPENTANE

Synonyms: amyl chloride

Formula:  $CH_3(CH_2)_3CH_2Cl$

Formula Weight: 106.6

Melting Point: -99°C.

Boiling Point:

108.2°C.

107°C.

(at 760 mm.)

(at 740 mm.)

## 1-CHLOROPENTANE (Cont.)

Specific Gravity: 0.883(20/4)

Refractive Index: 1.4119 at 18° C.

Inflammability Range (volume per cent  
in air): 1.4 (lower limit)

## Solubility:

insoluble in  
watersoluble in alcohol  
soluble in etherAdditional Data: vapor density, 3.67

## 2-CHLOROPENTANE

## Synonyms:

sec-amyl chloride    amyl chlorideFormula:  $\text{CH}_3\text{CHClCH}_2\text{CH}_2\text{CH}_3$ 

Formula Weight: 106.6

Boiling Point: 96 to 97° C. (at 760 mm.)

Specific Gravity: 0.870(20/4)

Refractive Index: 1.4060

## Solubility:

insoluble in  
watersoluble in alcohol  
soluble in ether

## 3-CHLOROPENTANE

Synonyms: amyl chloride

Formula:  $\text{CH}_3\text{CH}_2\text{CHClCH}_2\text{CH}_3$ 

Formula Weight: 106.6

## Boiling Point:

97.3° C. (at 760 mm.)

104 to 105° C. (at 760 mm.)

## Specific Gravity:

0.8967(15/4)

0.895 at 21° C.

Refractive Index: 1.4163 at 15° C.

## CHLOROPENTANES

Synonyms: (mixed amyl chlorides)

Formula:  $\text{C}_5\text{H}_{11}\text{Cl}$ 

Characteristics: straw to deep purple

Formula Weight: 106.6

## Boiling Point:

85 to 109° C. (at 760 mm.) 95%

## Vapor Pressure (mm. Hg):

42.8 at 20° C.

## Specific Gravity:

0.88(20/20)0.84(60/60)7.33 lbs. per gal. at 20° C.Refractive Index: 1.406

## Viscosity (centipoises):

0.54 at 25° C.0.36 at 60° C.Flash Point: 38° F. (open)

## Uses:

synthesis of amyl compounds  
solvent for many organic compounds,  
rotogravure inks, and synthetic  
rubber cement

## Additional Data:

coefficient of expansion, 0.0019 per ° C.water azeotrope is 90%  $\text{C}_5\text{H}_{11}\text{Cl}$  and  
boils at 77 to 82° C.kauri-butanol value, 71o-CHLOROPHENETOLE

## Synonyms:

1-chloro-2-ethoxybenzene

o-chlorophenyl ethyl etherFormula:  $\text{ClC}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 156.6

Boiling Point: 208° C. (at 760 mm.)

## Solubility:

soluble in alcohol, ether, and benzene

p-CHLOROPHENETOLE

## Synonyms:

1-chloro-4-ethoxybenzene

p-chlorophenyl ethyl etherFormula:  $\text{ClC}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 156.6

Melting Point: 21° C.

Boiling Point: 212° C. (at 760 mm.)

## Solubility:

soluble in alcohol    soluble in ether

$\beta$ -CHLOROPHENETOLEFormula:  $C_6H_5OCH_2CH_2Cl$ 

Characteristics: pleasant aromatic odor

Formula Weight: 156.6

Melting Point: 27 to 28° C.

Boiling Point:

221° C.	152 to 156° C.
(at 754 mm.)	(at 100 mm.)

Specific Gravity: 1.147(25/25)

Viscosity (centipoises):

3.5 at 25° C.	1.6 at 60° C.
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Flash Point: 107° F. (closed)

Solubility:

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether  
 soluble in carbon tetrachloride,  
 benzene, acetone, and methyl alcohol

o-CHLOROPHENOL

Synonyms:

1-chloro-2-hydroxybenzene  
 2-chloro-1-hydroxybenzene  
o-hydroxychlorobenzene  
 2-chlorophenol

Formula:  $ClC_6H_4OH$ 

Characteristics:

unpleasant phenolic, penetrating odor  
 straw colored toxic

Formula Weight: 128.6

Melting Point:

$\alpha$ 7° C.	$\gamma$ 4.1° C.
$\beta$ 0° C.	

Boiling Point: 175.6° C. (at 760 mm.)

Specific Gravity:

1.241(18/15)	1.254(25/25)
10.4 lbs. per gal. at 25° C.	

Refractive Index: 1.5473 at 40° C.

Uses:

intermediate in production of dyes and  
 other organic chemicals

Solubility (grams per 100 ml.):

2.85 (in water) at 20° C.  
 soluble in alcohol, ether, and alkalis  
 $\infty$  (in carbon tetrachloride)

Additional Data:

avoid breathing of vapors and contact  
 with the skin

2-CHLORO-o-PHENYLPHENOLFormula:  $C_6H_5C_6H_3(Cl)OH$ 

Formula Weight: 204.7

Melting Point: 6° C.


Boiling Point: 317 to 318° C. (at 760 mm.)

Specific Gravity: 1.234(25/25)

Solubility:

insoluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
 soluble in alkalis

## X-CHLOROPHENYL XENYL ETHER

Formula:  Cl

Characteristics:

pale straw colored viscous

Formula Weight: 280.7

Melting Point: -10° C.

Boiling Point: 180° C. (at 8 mm.)

Specific Gravity: 1.162(25/25)

Viscosity (centipoises):

89.4 at 25° C.	9.4 at 60° C.
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Flash Point: 315° F. (closed)

Solubility (grams per 100 ml.):

insoluble in water  
 23 (in methyl alcohol)  
 $\infty$  (in ether)  $\infty$  (in acetone)  
 $\infty$  (in carbon tetrachloride)  $\infty$  (in benzene)

## CHLOROPICRIN

## Synonyms:

chlorpicrin  
nitrochloroform  
nitrotrichloromethane  
trichloronitromethane

Formula:  $\text{CCl}_3\text{NO}_2$ 

## Characteristics:

oily                      refractive

Formula Weight: 164.4

## Melting Point:

 $-69.2^\circ\text{C.}$                        $-64^\circ\text{C.}$ 

## Boiling Point:

$112^\circ\text{C.}$  (at 760 mm.)  
 $112.3^\circ\text{C.}$  (at 766 mm.)

Vapor Pressure (mm. Hg): 16.91 at  $20^\circ\text{C.}$ 

## Specific Gravity:

$1.651(20/4)$                        $1.6579$  at  $20^\circ\text{C.}$   
 $1.6923(0/4)$

Refractive Index:  $1.4608$  at  $23^\circ\text{C.}$ Specific Heat (gram-calories per g.  
per  $^\circ\text{C.}$ ):  $0.235$  (liquid) at  $15$  to  $35^\circ\text{C.}$ Heat of Vaporization (gram-calories  
per g.):  $59$ 

## Uses:

dyes                      insecticides  
organic syntheses      rat extermination  
fumigants                lachrymator  
fungicides

## Solubility:

insoluble in water  
slightly soluble in ether  
soluble in carbon disulfide  
soluble in benzene

## Additional Data:

coefficient of expansion,  
 $0.00102$  per  $^\circ\text{C.}$  at  $0^\circ\text{C.}$ ,  $0.00110$   
per  $^\circ\text{C.}$  at  $50^\circ\text{C.}$   
volatility,  $184$  mg. per l. at  $20^\circ\text{C.}$   
vapor density,  $5.69$

## CHLOROPRENE

Synonyms: 2-chloro-1, 3-butadiene

Formula:  $\text{CH}_2:\text{CHCl}:\text{CH}_2$ 

Formula Weight: 88.5

Boiling Point:  $59.4^\circ\text{C.}$  (at 760 mm.)Specific Gravity:  $0.9583(20/20)$ Refractive Index:  $1.4583$ 

## Solubility:

slightly soluble       $\infty$  (in alcohol)  
in water                 $\infty$  (in ether)

## 1-CHLOROPROPANE

Synonyms: propyl chloride

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ 

## Characteristics:

volatile                      flammable

Formula Weight: 78.5

Melting Point:  $-122.8^\circ\text{C.}$ 

## Boiling Point:

$46.4^\circ\text{C.}$  (at 760 mm.)  
 $45$  to  $47.2^\circ\text{C.}$  (at 760 mm.)

## Specific Gravity:

$0.890(20/4)$   
 $0.888$  to  $0.890(25/25)$   
 $7.4$  lbs. per gal. at  $25^\circ\text{C.}$

## Refractive Index:

 $1.38856$                        $1.386$  at  $25^\circ\text{C.}$ Inflammability Range (volume per cent  
in air): $2.6$  (lower limit)       $10.5$  (upper limit)Flash Point:  $<10^\circ\text{F.}$  (closed)

## Solubility (grams per 100 ml.):

$0.27$  (in water) at  $20^\circ\text{C.}$   
 $\infty$  (in alcohol)                 $\infty$  (in ether)  
miscible with common organic solvents

## Additional Data:

fire point,  $<10^\circ\text{F.}$       vapor density,  $2.$ 

## 2-CHLOROPROPANE

Synonyms: isopropyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCl}$ 

## Characteristics:

volatile                      ethereal odor  
flammable

Formula Weight: 78.5

Melting Point:  $-117^{\circ}\text{C}$ .

Boiling Point:

36.5 $^{\circ}\text{C}$ . (at 760 mm.)

34.5 to 40.0 $^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.859 at 20 $^{\circ}\text{C}$ .

0.867(15.5/15.5)

0.862(25/25)

Refractive Index: 1.377

Flash Point:  $-49^{\circ}\text{F}$ . (closed)

Uses:

solvent in the organic syntheses of  
antiseptics, insecticides and rubber  
chemicals

Solubility (grams per 100 ml.):

0.31 (in water) at 20 $^{\circ}\text{C}$ .

$\infty$  (in alcohol)

$\infty$  (in carbon

$\infty$  (in ether)

tetrachloride)

$\infty$  (in acetone)

$\infty$  (in methyl

$\infty$  (in benzene)

alcohol)

$\infty$  (in VMP naphtha)

Additional Data: fire point,  $-4^{\circ}\text{F}$ .

### 3-CHLORO-1,2-PROPANEDIOL

Synonyms:

$\alpha$ -chlorohydrin

3-chloropropane-1,2-diol

glycerin  $\alpha$ -chlorohydrin

glycerol monochlorohydrin ( $\alpha$ )

$\alpha$ -monochlorohydrin

glyceryl  $\alpha$ -chlorohydrin

glycerin monochlorohydrin

glyceryl monochlorohydrin

the commercial product is a mixture  
of  $\alpha$  and  $\beta$  compounds

Formula:  $\text{CH}_2\text{ClCHOHCH}_2\text{OH}$

Formula Weight: 110.5

Boiling Point:

213 to 228 $^{\circ}\text{C}$ . (at 760 mm.) decomposes

Specific Gravity:

1.318(25/25)

1.326 at 18 $^{\circ}\text{C}$ .

Uses:

intermediate

novocain

explosives

solvent for acetyl cellulose, and

glyceryl phthalate resins

Solubility:

$\infty$  (in water)

$\infty$  (in ether)

$\infty$  (in alcohol)

immiscible in oils

miscible with some organic solvents

Additional Data:

unstable

hygroscopic

### 2-CHLORO-1,3-PROPANEDIOL

Synonyms:

$\beta$ -chlorohydrin

glycerin  $\beta$ -chlorohydrin

glycerol monochlorohydrin ( $\beta$ )

$\beta$ -monochlorohydrin

glyceryl  $\beta$ -chlorohydrin

Formula:  $(\text{CH}_2\text{OH})_2\text{CHCl}$

Formula Weight: 110.5

Boiling Point: 146 $^{\circ}\text{C}$ . (at 18 mm.)

Specific Gravity: 1.321(20/4)

### 2-CHLORO-1-PROPANOL

Synonyms:

$\beta$ -chloropropyl alcohol

prim-propylene chlorohydrin

Formula:  $\text{CH}_3\text{CHClCH}_2\text{OH}$

Formula Weight: 94.5

Boiling Point: 133 to 134 $^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.103 at 20 $^{\circ}\text{C}$ .

Flash Point:

125 $^{\circ}\text{F}$ . (open)

125 $^{\circ}\text{F}$ . (closed)

Solubility:

soluble in water

soluble in alcohol

Additional Data: vapor density, 3.26



## Boiling Point:

230° C. (at 764 mm.)

22.65° C. (at 760 mm.)

Specific Gravity: 0.918 at 9° C.

Solubility: insoluble in water

## 3-CHLOROPROPENE

## Synonyms:

allyl chloride

3-chloro-1-propene

Formula:  $\text{CH}_2\text{:CHCH}_2\text{Cl}$ 

Characteristics: poisonous

Formula Weight: 76.5

Melting Point: -136.4 to -134.5° C.

## Boiling Point:

44.6° C. (at 760 mm.)

43 to 49° C. (at 760 mm.)

## Specific Gravity:

0.938(20/4)

0.937 to 0.940(20/20)

7.81 lbs. per gal. at 20° C.

Refractive Index: 1.4154

## Flash Point:

-20° F. (open)

-25° F. (closed)

Specific Heat (gram-calories per g. per ° C.): 0.315 (liquid) at 0° C.

Heat of Vaporization (gram-calories per g.): 83.8

Heat of Combustion (gram-calories per g.): 5940 (liquid)

Uses: organic syntheses

Solubility (grams per 100 ml.):

0.1 (of water)

0.1 (in water)

very soluble in alcohol

 $\infty$  (in ether)

## Additional Data:

coefficient of expansion,

0.000783 per ° F.

## 2-CHLORO-2-PROPEN-1-OL

Synonyms:  $\beta$ -chloroallyl alcoholFormula:  $\text{CH}_2\text{:CClCH}_2\text{OH}$ 

Formula Weight: 92.5

Boiling Point: 136 to 140° C. (at 760 mm.)

## 3-CHLORO-2-PROPEN-1-OL

Synonyms:  $\gamma$ -chloroallyl alcoholFormula:  $\text{CHCl:CHCH}_2\text{OH}$ 

Formula Weight: 92.5

Boiling Point: 153° C. (at 760 mm.)

 $\alpha$ -CHLOROPROPIONIC ACID

Synonyms: 2-chloropropanoic acid

Formula:  $\text{CH}_3\text{CHClCOOH}$ 

Characteristics: characteristic odor

Formula Weight: 108.5

Melting Point: &lt; -20° C.

Boiling Point: 186° C. (at 760 mm.)

## Specific Gravity:

1.28 at 0° C.

1.306 at 9° C.

## Solubility:

 $\infty$  (in water) $\infty$  (in ether) $\infty$  (in alcohol)

## 3-CHLOROPROPYNE

## Synonyms:

chloroallylene

propargyl chloride

Formula:  $\text{CH:CCH}_2\text{Cl}$ 

Formula Weight: 74.5

Boiling Point: 65° C. (at 760 mm.)

Specific Gravity: 1.0454 at 5° C.

Solubility: insoluble in water

 $\infty$  (in alcohol) $\infty$  (in ether)

## CHLOROPROPIONYL CHLORIDE

Formula:  $\text{CH}_2\text{ClCH}_2\text{COCl}$ 

Formula Weight: 127.0

Boiling Point: 143 to 145° C. (at 763 mm.)

Specific Gravity: 1.331 at 13° C.

## Solubility:

decomposes in water

decomposes in alcohol

$\beta$ -CHLOROPROPYL ACETATEFormula:  $\text{CH}_3\text{COOCH}_2\text{CHClCH}_3$ 

Characteristics: pleasant odor

Formula Weight: 136.6

Boiling Point: 152 to 153°C. (at 750 mm.)

Specific Gravity: 1.250 at 19°C.

Uses: solvent for cellulose esters

Solubility:

insoluble in  
watersoluble in alcohol  
soluble in ether $\gamma$ -CHLOROPROPYL ACETATEFormula:  $\text{CH}_3\text{COO}(\text{CH}_2)_2\text{CH}_2\text{Cl}$ 

Formula Weight: 136.6

Boiling Point: 163 to 165°C. (at 747 mm.)

Specific Gravity: 1.250 at 19°C.

 $\gamma$ -CHLOROPROPYL CHLOROFORMATE

Synonyms:

 $\gamma$ -chloropropyl chlorocarbonateFormula:  $\text{ClCOO}(\text{CH}_2)_2\text{CH}_2\text{Cl}$ 

Characteristics: yellow

Formula Weight: 157.0

Boiling Point: 58 to 60°C. (at 8 mm.)

Solubility:

decomposes in water

decomposes in alcohol

 $\beta$ -CHLOROPROPYL-  
p-TOLUENESULFONATEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SO}_3(\text{CH}_2)_2\text{CH}_2\text{Cl}$ 

Formula Weight: 248.7

Boiling Point: 150 to 151°C. (at 12.5 mm.)

## 2-CHLOROPYRIDINE

Synonyms:  $\alpha$ -chloropyridineFormula:  $\text{ClC}_5\text{H}_4\text{N}$ 

Characteristics: oily

Formula Weight: 113.6

Boiling Point:

166°C. (at 741 mm.)

170°C. (at 760 mm.)

Specific Gravity: 1.205 at 15°C.

Solubility:

very slightly soluble in water  
soluble in ether

## 3-CHLOROPYRIDINE

Synonyms:  $\beta$ -chloropyridineFormula:  $\text{ClC}_5\text{H}_4\text{N}$ 

Formula Weight: 113.6

Boiling Point: 148°C. (at 744 mm.)

Solubility: soluble in water

## 4-CHLOROPYRIDINE

Synonyms:  $\gamma$ -chloropyridineFormula:  $\text{ClC}_5\text{H}_4\text{N}$ 

Formula Weight: 113.6

Boiling Point: 147 to 148°C. (at 760 mm.)

Solubility: soluble in water

## 8-CHLOROQUINOLINE

Formula:  $\text{ClC}_9\text{H}_6\text{N}$ 

Characteristics:

yellow

oily

Formula Weight: 163.6

Melting Point: &lt; -20°C.

Boiling Point: 288°C. (at 760 mm.)

Solubility:

very soluble in alcohol

very soluble in ether

 $\alpha$ -CHLOROSTYRENE

Synonyms: 1-chloro-1-phenylethylene

Formula:  $\text{C}_6\text{H}_5\text{CCl:CH}_2$ 

Formula Weight: 138.6

Melting Point:  $-23^{\circ}\text{C}$ .

Boiling Point:  $199^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.1016(18/4)

Refractive Index: 1.5623 at  $17^{\circ}\text{C}$ .

Solubility: insoluble in water  
soluble in alcohol    soluble in ether

### $\beta$ -CHLOROSTYRENE

Synonyms:

$\omega$ -chlorostyrene

1-chloro-2-phenylethylene

Formula:  $\text{C}_6\text{H}_5\text{CH}:\text{CHCl}$

Formula Weight: 138.6

Boiling Point:  $199^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

1.110(18/4)                      1.112(15/4)

Solubility: insoluble in water  
soluble in alcohol    soluble in ether

### m-CHLOROSULFONYL BENZOYL CHLORIDE

Synonyms: m-sulfobenzoyl dichloride

Formula:  $\text{ClSO}_2\text{C}_6\text{H}_4\text{COCl}$

Formula Weight: 239.1

Melting Point:  $20.4^{\circ}\text{C}$ .

Boiling Point: 153 to  $154^{\circ}\text{C}$ . (at 7 mm.)

### 2-CHLOROTHIOPHENE

Formula:  -Cl

Formula Weight: 118.5

Boiling Point:  $125$  to  $130^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.286(20/4)

Refractive Index: 1.5488

Uses: organic syntheses

Additional Data: 95% pure

### CHLOROTOLUENE

Synonyms:

methylchlorbenzene

monochlorotoluene

a commercial mixture of the o- and  
p-isomers

Formula:  $\text{ClC}_6\text{H}_4\text{CH}_3$

Characteristics:

clear colorless to straw colored  
odor like that of chlorobenzene

Formula Weight: 126.6

Freezing Point:  $< -45^{\circ}\text{C}$ .

Boiling Point:  $158$  to  $165^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.080(15.5/15.5)

Refractive Index: 1.522

Flash Point:  $122$  to  $129^{\circ}\text{F}$ . (open)

Uses:

solvent for rubber and synthetic resins  
chemical intermediate in the manufac-  
ture of rubber accelerators and other  
organic chemicals

Solubility:

insoluble in water  
completely miscible with most organic  
solvents

Additional Data: fire point,  $186.8^{\circ}\text{F}$ .

### d-CHLOROTOLUENE

Synonyms:

benzyl chloride              d-chlorotoluol

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$

Characteristics: aromatic odor

Formula Weight: 126.6

Melting Point:  $-48$  to  $-39^{\circ}\text{C}$ .

Boiling Point:

$179^{\circ}\text{C}$ . (at 760 mm.)

$179.4^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

1.1026(18/4)

1.100(20/20)

Refractive Index: 1.5415 at  $15^{\circ}\text{C}$ .

## d-CHLOROTOLUENE (Cont.)

Heat of Combustion (kilogram-calories per g.-mol): 886.4 (liquid)

## Uses:

dyes                      pharmaceuticals  
organic syntheses      synthetic resins  
perfumes

## Solubility:

insoluble in cold water  
decomposes in hot water  
 $\infty$  (in alcohol)               $\infty$  (in chloroform)  
 $\infty$  (in ether)

Additional Data: vapor density, 4.36

m-CHLOROTOLUENE

## Synonyms:

tolyl chloride  
3-chloro-1-methylbenzene

Formula:  $\text{ClC}_6\text{H}_4\text{CH}_3$

Formula Weight: 126.6

Melting Point:  $-43.8^\circ\text{C}$ .

Boiling Point:  $161.6^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.0722(20/4)

Refractive Index: 1.5214 at  $19^\circ\text{C}$ .

## Solubility:

slightly soluble in water  
soluble in alcohol  
 $\infty$  (in ether)  
very soluble in chloroform  
very soluble in benzene

o-CHLOROTOLUENE

## Synonyms:

tolyl chloride  
2-chloro-1-methylbenzene

Formula:  $\text{ClC}_6\text{H}_4\text{CH}_3$

Formula Weight: 126.6

Melting Point:  $-34$  to  $-36^\circ\text{C}$ .

## Boiling Point:

150 to  $160^\circ\text{C}$ . (at 760 mm.)  
 $159.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.0817(20/4)

Refractive Index: 1.5238

## Uses:

solvent  
intermediate for organic chemicals  
and dyes

## Solubility:

slightly soluble in water  
soluble in alcohol  
 $\infty$  (in ether)  
very soluble in chloroform  
very soluble in benzene

Additional Data: volatile in steam

p-CHLOROTOLUENE

## Synonyms:

tolyl chloride  
4-chloro-1-methylbenzene

Formula:  $\text{ClC}_6\text{H}_4\text{CH}_3$

Formula Weight: 126.6

Melting Point:  $7.5^\circ\text{C}$ .

## Boiling Point:

$162.2^\circ\text{C}$ . (at 760 mm.)  
162 to  $166^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.0697(20/4)

Refractive Index: 1.5199 at  $19^\circ\text{C}$ .

## Uses:

solvent  
intermediate for organic chemicals  
and dyes

## Solubility:

insoluble in water       $\infty$  (in ether)  
soluble in alcohol  
very soluble in chloroform  
very soluble in benzene

m-CHLORO-p-TOLUIDINE

Formula:  $\text{ClC}_6\text{H}_3(\text{CH}_3)\text{NH}_2$

Formula Weight: 141.6

Melting Point:  $7^\circ\text{C}$ .

Boiling Point: 222 to  $223^\circ\text{C}$ . (at 760 mm)

Specific Gravity: 1.151 at  $20^\circ\text{C}$ .

Solubility: insoluble in water

## 1,1,2-CHLOROTRIBROMOETHANE

Formula:  $\text{CH}_2\text{BrCClBr}_2$ 

Formula Weight: 301.2

Boiling Point: 165 to 167° C. (at 285 mm.)

Specific Gravity: 2.602 at 16° C.

Solubility: insoluble in water

## 1-CHLORO-1,2,2,-TRIFLUOROETHANE

Synonyms:

1,2,2-trifluoro-1-chloroethane

Formula:  $\text{CHF}_2\text{CHFCI}$ 

Formula Weight: 118.5

Boiling Point: 17° C. (at 760 mm.)

Specific Gravity: 1.365 at 0° C.

Solubility: very soluble in alcohol

 $\alpha$ -CHLORO-m-XYLENE

Synonyms:

 $\omega$ -chloro-m-xylenem-xylyl chlorideFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{Cl}$ 

Formula Weight: 140.6

Boiling Point: 195 to 196° C. (at 760 mm.)

Specific Gravity: 1.064 at 20° C.

Solubility:

insoluble in water

 $\infty$  (in absolute alcohol) $\infty$  (in ether) $\alpha$ -CHLORO-o-XYLENE

Synonyms:

 $\omega$ -chloro-o-xyleneo-xylyl chlorideFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{Cl}$ 

Formula Weight: 140.6

Boiling Point: 195 to 203° C. (at 760 mm.)

Solubility:

insoluble in water

 $\infty$  (in absolute alcohol) $\infty$  (in ether) $\alpha$ -CHLORO-p-XYLENE

Synonyms:

 $\omega$ -chloro-p-xylenep-xylyl chlorideFormula:  $\text{CH}_3\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$ 

Formula Weight: 140.6

Boiling Point: 200 to 202° C. (at 760 mm.)

Solubility:

insoluble in water

 $\infty$  (in absolute alcohol) $\infty$  (in ether)

## CHROMAN

Synonyms:

3,4-dihydro-1,2-benzopyran

2,3-dihydro-1,4-benzopyran

Formula:  $\text{C}_9\text{H}_{10}\text{O}$ 

Formula Weight: 134.2

Boiling Point:

214 to 215° C. (at 749 mm.)

95° C. (at 12 mm.)

Specific Gravity: 1.064

Refractive Index: 1.544

Solubility:

soluble in hot water

highly soluble in organic solvents

## CINEOLE

Synonyms:

cajeputole

1,8-epoxy-p-menthane

eucalyptole

1,3,3-trimethyl-2-oxabicyclo-  
[2.2.2]octane1,8-oxido-p-menthaneFormula:  $\text{C}_{10}\text{H}_{18}\text{O}$ 

Characteristics:

bitter-sweet odor oily

eucalyptus aroma

camphor-like odor resembling

eucalyptus

Formula Weight: 154.3

## CINEOLE (Cont.)

Melting Point: 1 to 1.5° C.

Boiling Point: 176 to 177° C. (at 760 mm.)

Specific Gravity:

0.9239(20/4) 0.927 at 20° C.

Refractive Index: 1.4584 at 15° C.

Uses:

drugs flavors  
synthetic eucalyptus type essences

Solubility (grams per 100 ml.):

0.2 (in cold water) ∞ (in alcohol)

1.9 (in water) at 15° C. ∞ (in ether)

soluble in chloroform, glacial acetic acid, and oils

Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
50	1:11-16
60	1:4-5
70	1:1.5-2
90	1:1

## 1, 4-CINEOLE

Synonyms:

p-cineole  
1, 4-epoxy-p-menthane

Formula: C<sub>10</sub>H<sub>18</sub>O

Formula Weight: 154.3

Melting Point: 1° C.

Boiling Point: 173.4° C. (at 760 mm.)

Specific Gravity: 0.8997 at 20° C.

Refractive Index: 1.4479 at 18° C.

Solubility (grams per 100 ml.):

0.2 (in cold water) ∞ (in alcohol)  
∞ (in ether)

## CINNAMALDEHYDE

Synonyms:

cinnamal β-phenylacrolein  
cinnamic aldehyde 3-phenylpropenal  
cinnamyl aldehyde

Formula: C<sub>6</sub>H<sub>5</sub>CH:CHCHO

Characteristics:

colorless to yellow cinnamon odor  
oily almond flavor  
sweet, burning taste

Formula Weight: 133.2

Melting Point: -7.5° C.

246.0° C. (at 760 mm.)

251 to 252° C. (at 760 mm.) slight decomposition

248° C. (at 760 mm.)

Specific Gravity:

1.110(20/20) 1.049(20/4)

1.1119(15/4)

Refractive Index: 1.61949

Heat of Combustion (kilogram-calories per g.-mol): 1112.3 (liquid)

Uses:

perfumes flavors  
extracts soap perfumes  
synthetic apricot, banana, butterscotch,  
cacao, almond, cherry, date, grena-  
dine, plum, raspberry, and straw-  
berry essences

Solubility (grams per 100 ml.):

very slightly soluble in water

4 (in 50% alcohol)

∞ (in ether) ∞ (in chloroform)

insoluble in benzine

Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
50	1:25
60	1:7
70	1:3
90	1:1

Additional Data:

should be stored in tightly closed  
container  
volatile in steam  
oxidizes in air to cinnamic acid

## CITRACONIC ANHYDRIDE

Synonyms: methylmaleic anhydride

Formula: CH<sub>3</sub>C:CHCOOCO

Formula Weight: 112.1

Melting Point: 7 to 8°C.

Boiling Point:

213.5°C. (at 760 mm.)

213 to 214°C. (at 760 mm.)

Specific Gravity: 1.25(15/4)

Solubility:

decomposes in water

very soluble in alcohol

very soluble in ether

### d-CITRAL

Synonyms:

geranial

geranialdehyde

2, 6-dimethyl-2, 6-octadien-8-al

Formula:  $C_9H_{15}CHO$

Characteristics:

colorless to pale yellow

strong lemon odor

oily

Formula Weight: 152.2

Boiling Point:

224 to 229°C. (at 760 mm.) slight

decomposition

Specific Gravity:

0.890(17/4)

0.8868(20/4)

Refractive Index: 1.4875

Uses:

lemon flavors

perfumes

lemon oil

Solubility:

insoluble in

$\infty$  (in alcohol)

water

$\infty$  (in ether)

Additional Data:

should be protected from light

### d-CITRONELLAL

Synonyms: d-rhodinal

Formula:

$CH_3:C(CH_3)(CH_2)_3CH(CH_3)CH_2CHO$

Characteristics:

colorless to pale yellow

oily

Formula Weight: 154.3

Boiling Point:

204 to 208°C. (at 760 mm.)

206.5°C. (at 760 mm.)

Specific Gravity:

0.855 to 0.857 at 20°C.

Refractive Index: 1.4483 at 17.5°C.

Solubility:

very slightly soluble in water

$\infty$  (in alcohol)

$\infty$  (in ether)

Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
45	1:33
50	1:20
60	1:4
70	1:2
90	1:1

Additional Data:

optical rotation -2 to +4°

### d-CITRONELLOL

Synonyms:

2, 6-dimethyloctene-1-ol-8

rhodinol

Formula:  $C_{10}H_{19}OH$

Characteristics:

oily

bitter-grassy

faint rose odor

taste

Formula Weight: 156.3

Boiling Point:

222°C. (at 760 mm.)

221.5°C. (at 760 mm.)

221.5°C. (at 755 mm.)

Specific Gravity:

0.856 at 8°C.

0.850 to 0.857

0.8565(17/4)

at 15°C.

Refractive Index: 1.45659

Uses:

honey flavors

rose perfumes

Solubility:

very slightly soluble in water

$\infty$  (in alcohol)

$\infty$  (in ether)

## CITRONELLYL ACETATE

## Synonyms:

acetic acid citronellyl ester  
citronellyl acetic ether

Formula:  $C_{10}H_{19}OOCCH_3$

## Characteristics:

odor of a fruity bergamot pear type  
resembling lavender  
sweet taste                  apricot aroma

Formula Weight: 198.3

## Boiling Point:

172 to 173°C. (at 34 mm.)  
217.0°C. (at 760 mm.)  
119 to 121°C. (at 15 mm.)

## Specific Gravity:

0.893 at 17.5°C.      0.9013 at 15°C.

Refractive Index: 1.4489

## Uses:

perfumes  
synthetic apricot, honey, pear, quince,  
and woodruff flavors

## Solubility:

soluble in alcohol, one volume is  
soluble in 330 volumes of 45%  
alcohol and 6 to 7 volumes of  
70% alcohol

## CLUPANODONIC ACID

Formula:  $C_{21}H_{33}COOH$

## Characteristics:

pale yellow                  oily

Formula Weight: 330.5

Melting Point: < -78°C.

Boiling Point: 236°C. (at 5 mm.)

Specific Gravity: 0.9410(15/4)

Refractive Index: 1.5057 at 15°C.

## Solubility:

insoluble in water      soluble in ether

 $\alpha$ -COLLIDINE

Synonyms: 2-methyl-4-ethylpyridine

Formula:  $CH_3C_5H_3NC_2H_5$

Formula Weight: 121.2

## Boiling Point:

179°C. (at 760 mm.)  
177.8°C. (at 758 mm.)

## Specific Gravity:

0.9268(16/4)                  0.935 at 0°C.

## Solubility:

soluble in cold water  
less soluble in hot water  
very soluble in alcohol  
very soluble in ether  
soluble in benzene

 $\beta$ -COLLIDINE

## Synonyms:

4-methyl-3-ethylpyridine

Formula:  $CH_3C_5H_3NC_2H_5$

Formula Weight: 121.2

Boiling Point: 195 to 196°C. (at 760 mm.)

## Specific Gravity:

0.966(0/4)                  0.9286(16.8/4)

## Solubility:

insoluble in water  
soluble in alcohol, ether, and  
chloroform

 $\gamma$ -COLLIDINE

## Synonyms:

2, 4, 6-trimethylpyridine

Formula:  $(CH_3)_3C_5H_2N$

Formula Weight: 121.2

Boiling Point: 171 to 172°C. (at 760 mm.)

## Specific Gravity:

0.917 at 15°C.                  0.917(20/4)

## Solubility (grams per 100 ml.):

20.8 (in water) at 6°C.,  
3.5 (in water) at 20°C.  
soluble in alcohol      ∞ (in ether)

## YLENE

Synonyms: octadiene - x, x

Formula:  $C_8H_{14}$

Formula Weight: 110.2

Boiling Point: 126° C. (at 738 mm.)

Specific Gravity:

0.761 at 15° C.      0.770(0/0)

Solubility: soluble in alcohol

## CREOSOL

Synonyms:

2-methoxy-p-cresol

2-methoxy-4-methylphenol

4-methylguaiacol

Formula:  $CH_3OC_6H_3(CH_3)OH$

Characteristics: oily

Formula Weight: 138.2

Melting Point: 5.5° C.

Boiling Point:

221.8° C. (at 760 mm.)

221 to 222° C. (at 765 mm.)

113.5° C. (at 723 mm.)

Specific Gravity:

1.092(20/20)      1.0919(25/4)

Refractive Index: 1.5353 at 25° C.

Solubility:

very slightly soluble in water

∞ (in alcohol)      ∞ (in chloroform)

∞ (in ether)      ∞ (in benzene)

m-CRESOL

Synonyms:

m-methylphenol      m-oxytoluene

m-hydroxytoluol      cresylic acid

m-cresylic acid

Formula:  $CH_3C_6H_4OH$

Characteristics:

colorless to yellow      oily

phenolic odor      poisonous

Formula Weight: 108.1

Melting Point: 10.9 to 12° C.

Boiling Point: 202 to 208° C. (at 760 mm.)

Specific Gravity:

1.034(20/4)

8.66 lbs. per gal. at 20° C.

Refractive Index: 1.5398

Flash Point: 86° F. (closed)

Heat of Combustion (kilogram-calories  
per g.-mol): 880.5

Uses:

antiseptic

synthetic resins

disinfectant

photographic

fumigant

developer

organic syntheses

explosives

Solubility (grams per 100 ml.):

2.35 (in water) at 20° C.

∞ (in alcohol)

∞ (in ether)

soluble in chloroform

soluble in common organic solvents

Additional Data:

about 1/4 as toxic as phenol

## CROTONALDEHYDE

Synonyms:

2-butenal

$\beta$ -methylacrolein

2-buten-1-al

propylene aldehyde

crotonic aldehyde

Formula:  $CH_3CH:CHCHO$

Characteristics:

penetrating odor

straw colored

mobile

inflammable

Formula Weight: 70.1

Melting Point:

-69° C.

freezes at -74° C.

Boiling Point:

102.4° C. (at 760 mm.)

103 to 105° C. (at 760 mm.)

99 to 104° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 19.0 at 20° C.

Specific Gravity:

0.8537(20/20)

0.8755(15/4)

0.852 to 0.858 at 20° C.

7.111 lbs. per gal. at 20° C.

## CROTONALDEHYDE (Cont.)

## Refractive Index:

1.4737                      1.43838 at 17.3° C.

## Inflammability Range (volume per cent in air):

2.95 (lower limit)      15.5 (upper limit)

## Flash Point:

127.4° F. (open)      55° F. (closed)

## Specific Heat (gram-calories per g. per °C.): 0.705 (liquid)

## Heat of Combustion (kilogram-calories per g.-mol): 542.1 (liquid)

## Uses:

solvent for oils, rosin, shellac, wood  
distillation resins, varnishes  
organic syntheses      fuel gas warming  
leather tanning              agent  
lachrymator

## Solubility (grams per 100 ml.):

9.5 (of water)              15-18 (in water)  
very soluble in alcohol  
∞ (in ether)              ∞ (in gasoline)  
∞ (in benzene)              ∞ (in solvent)  
∞ (in toluene)              naphtha)  
∞ (in kerosene)

## Additional Data:

volatile in steam, unstable  
becomes yellow on exposure to air  
and light  
vapor density, 2.41  
water azeotrope, 20% water  
boiling point, 84° C., d. 2.41

## CROTONIC ANHYDRIDE

## Synonyms: 2-butenic anhydride

Formula:  $(\text{CH}_3\text{CH}:\text{CHCO})_2\text{O}$ 

Formula Weight: 154.2

Boiling Point: 246 to 248° C. (at 760 mm.)

Specific Gravity: 1.0397(20/4)

Refractive Index: 1.47446

## Solubility:

decomposes in water  
decomposes in alcohol  
∞ (in ether)

## CROTONONITRILE

## Synonyms:

2-butenenitrile              propenyl cyanide

Formula:  $\text{CH}_3\text{CH}:\text{CHCN}$ 

Formula Weight: 67.1

## Boiling Point:

118 to 119° C. (at 760 mm.)  
117 to 118° C. (at 744 mm.)

Specific Gravity: 0.826(23/4)

## Solubility:

decomposes in water  
decomposes in alcohol

## CUMALDEHYDE

## Synonyms:

cuminal  
p-cuminic aldehyde  
p-isopropylbenzaldehyde

Formula:  $(\text{CH}_3)_2\text{CHC}_6\text{H}_4\text{CHO}$ 

## Characteristics:

colorless to yellow      oily  
strong, disagreeable, persistent odor  
bitter-sweet taste      strawberry flavor

Formula Weight: 148.2

Boiling Point: 235 to 237° C. (at 760 mm.)

Specific Gravity: 0.978(20/4)

Refractive Index: 1.5301

## Uses:

shading blackberry, black currant,  
strawberry, and gooseberry flavors

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether  
one volume dissolves in 7 volumes of  
70% alcohol

## CUMENE

## Synonyms:

cumol                      isopropylbenzol  
isopropylbenzene      2-phenylpropane

Formula:  $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)_2$

## Characteristics:

mobile  
pleasant, characteristic odor

Formula Weight: 120.2

## Melting Point:

-96.9° C.                      -90.0° C.

## Boiling Point:

152 to 153° C. (at 760 mm.)  
152.4° C. (at 760 mm.)

## Specific Gravity:

0.86(20/4)                      0.861(25/25)  
7.19 lbs. per gal. at 25° C.

## Refractive Index:

1.49130                      1.489 at 25° C.

## Viscosity (centipoises):

0.73 at 25° C.                      0.6 at 60° C.

## Flash Point: 102° F. (closed)

Specific Heat (gram-calories per g.  
per ° C.): 0.43

## Heat of Vaporization:

76.5 (gram-calories per g.) at the  
boiling point  
134.3 (Btu. per lb.) at the boiling point  
161.48 (Btu. per lb.) at 77° F.

## Uses:

diluent                      lacquers  
organic syntheses

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether  
soluble in benzene  
soluble in carbon tetrachloride

## Additional Data:

fire point, 100.4° F.  
aniline point, < -22  
dielectric constant (1,000 cycles), -2.3  
dielectric strength, 21,000 volts  
(0.1" gap)  
power factor (1,000 cycles), < 0.05%  
specific resistivity,  
8.6 x 10<sup>12</sup> (at 12° C.) ohms per cm.  
specific gravity of gas (ideal, air = 1.0),  
4.1492

specific gravity of liquid (in vacuo),  
0.86175(20/4)° C. 0.86638(60/60)° F.  
API gravity at 60° F., 31.8  
liquid density (in vacuo) at 60° F.,  
7.2232  
coefficient of expansion,  
0.0054 at 32 to 104° F.  
critical pressure, 473 p.s.i.a.  
critical temperature, 685° F.  
total heating values at (77° F.)  
18657 Btu. per lb.,  
133510 Btu. per cubic ft. (gas),  
vapor density, 4.14

## CUMIDINE

Synonyms: p-isopropylaniline

Formula: (CH<sub>3</sub>)<sub>2</sub>CHC<sub>6</sub>H<sub>4</sub>NH<sub>2</sub>

Formula Weight: 135.2

Melting Point: -63° C.

Boiling Point: 225° C. (at 760 mm.)

Specific Gravity: 0.957(20/4)

## Solubility:

insoluble in water      soluble in ether  
soluble in alcohol      soluble in benzene

## CUMINYL ALCOHOL

## Synonyms:

p-cumic alcohol      cuminol  
p-cuminic alcohol      p-isopropylbenzyl  
cumol                      alcohol

Formula: (CH<sub>3</sub>)<sub>2</sub>CHC<sub>6</sub>H<sub>4</sub>CH<sub>2</sub>OH

## Characteristics:

colorless to yellow  
oily  
strawberry aroma  
burning aromatic taste  
caraway-like persistent taste

Formula Weight: 150.2

## Boiling Point:

246 to 248.4° C. (at 760 mm.)

## Specific Gravity:

0.975(25/25)                      0.981 at 15° C.  
0.978(20/20)

Refractive Index: 1.522 at 24° C.

## CUMINYL ALCOHOL (Cont.)

## Uses:

shading apricot, date, strawberry, and  
gooseberry flavors

Solubility: soluble in water

∞ (in alcohol)      ∞ (in ether)

## CYANOPROPIONIC ACID

## Synonyms:

2-cyanopropanoic acid  
methylecyano acetic acid  
methylmalonic mononitrile

Formula:  $\text{CH}_3\text{CH}(\text{CN})\text{COOH}$

Characteristics: oily

Formula Weight: 99.1

Boiling Point: 142 to 145°C. (at 11 mm.)

Specific Gravity: 1.14(20/4)

Solubility:

soluble in water      soluble in alcohol

## CYCLOHEPTANE

## Synonyms:

heptamethylene      suberane

Formula:  $\text{CH}_2(\text{CH}_2)_5\text{CH}_2$

Characteristics: oily

Formula Weight: 98.2

Melting Point: -12°C.

Boiling Point: 118 to 120°C. (at 760 mm.)

Specific Gravity: 0.8099(20/4)

Refractive Index: 1.4440

Heat of Combustion (kilogram-calories  
per g.-mol): 1087.3 (liquid)

Solubility: insoluble in water

## CYCLOHEPTANONE

## Synonyms:

ketoheptanethylene      suberone

Formula:  $\text{CH}_2(\text{CH}_2)_5\text{CO}$

Characteristics: oily

Formula Weight: 112.2

Boiling Point:

179 to 181°C. (at 760 mm.)

179.5°C. (at 760 mm.)

Specific Gravity: 0.9508(20/4)

Refractive Index: 1.4603 at 21.9°C.

Solubility: insoluble in water

soluble in alcohol      soluble in ether

## CYCLOHEPTENE

## Synonyms:

suberene      suberylene

Formula:  $\text{CH}_2(\text{CH}_2)_4\text{CH}=\text{CH}$

Characteristics: oily

Formula Weight: 96.2

Boiling Point: 114 to 115°C. (at 760 mm.)

Specific Gravity: 0.8328(20/4)

Refractive Index: 1.4452

Heat of Combustion (kilogram-calories  
per g.): 1049.9 (liquid)

Solubility: insoluble in water

soluble in alcohol      soluble in ether

## 1,3-CYCLOHEXADIENE

## Synonyms:

$\Delta^{1,3}$ -cyclohexadiene

o-dihydrobenzene

1,2-dihydrobenzene

Formula:  $\text{CH}=\text{CHCH}=\text{CHCH}_2\text{CH}_2$

Formula Weight: 80.1

Melting Point: -98°C.

Boiling Point: 79 to 84°C. (at 760 mm.)

Specific Gravity:

0.842(20/20)

0.8404(20/20)

Refractive Index: 1.4744 to 1.4758

Solubility:

insoluble in water

soluble in alcohol

very soluble in ether

## 1,4-CYCLOHEXADIENE

## Synonyms:

p-dihydrobenzene  $\Delta^{1,4}$ -cyclo-  
1,4-dihydrobenzene hexadiene

Formula:  $\text{CH:CHCH}_2\text{CH:CHCH}_2$

Formula Weight: 80.1

## Boiling Point:

85.5° C. (at 760 mm.)  
86 to 87° C. (at 760 mm.)  
81 to 82° C. (at 760 mm.)

Specific Gravity: 0.8471 to 0.898

Refractive Index: 1.4681 at 19° C.

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## CYCLOHEXANE

## Synonyms:

benzene hexahydride  
hexahydrobenzene  
hexamethylene

Formula:  $\text{CH}_2(\text{CH}_2)_4\text{CH}_2$

## Characteristics:

characteristic aromatic odor of chloroform, and oil of rose mobile

Formula Weight: 84.2

## Melting Point:

6.5° C. 3° C. minimum

## Boiling Point:

80 to 81° C. (at 760 mm.)  
80 to 83° C. (at 760 mm.)

## Specific Gravity:

0.7791(20/4)  
6.5 lbs. per gal. at 20° C.

## Refractive Index:

1.4290 at 15° C. 1.42623  
1.4273

Viscosity (centipoises): 0.8 at 25° C.

Inflammability Range (volume per cent in air):

1.2 (lower limit) 8.3 (upper limit)

## Flash Point:

40° F. (open) 1.8° F. (closed)

## Specific Heat (Btu./lb./° F.):

0.440 (liquid) at 78.6° F.  
0.421 (vapor) at 250° F.

## Heat of Vaporization (Btu. per lb.):

153.9 at the boiling point  
168.75 at 77° F.

## Heat of Combustion (kilogram-calories per g.-mol): 937.8 (liquid)

## Uses:

solvent for cellulose ethers, fats, crude rubber, oils, paint and varnish remover

## Solubility (grams per 100 ml.):

insoluble in  $\infty$  (in alcohol)  
water  $\infty$  (in ether)  
57 (in methyl alcohol) at 20° C.  
 $\infty$  (in acetone)  $\infty$  (in carbon tetrachloride)  
 $\infty$  (in benzene) miscible with most lacquer solvents

## Additional Data:

Evaporation Ratio (toluene = 100), 195  
heat of fusion (gram-calories per g.), 7.4 at 15° C.  
vapor density, 2.90  
coefficient of expansion, 0.00068 at 68 to 104° F.  
specific gravity of gas (ideal) (air = 1.0), 2.9053  
specific gravity of liquid (in vacuo): 0.77855(20/4)° C. 0.78344(60/60)° F.  
API gravity at 60° F., 49.1  
liquid density (in vacuo) at 60° F., 6.5317  
fire point, <32° F.  
aniline point, 86.4° F.  
critical temperature, 279.9° C.  
critical pressure, 39.8 atm.

## CYCLOHEXANOL

## Synonyms:

Anol hexahydro-  
Adronol phenol  
Hexalin Hydralin

Formula:  $\text{CH}_2(\text{CH}_2)_4\text{CHOH}$

## CYCLOHEXANOL (Cont.)

## Characteristics:

pleasant aromatic odor  
slightly toxic non-explosive  
viscous

Formula Weight: 100.2

## Melting Point:

22 to 25°C. 23.9°C.  
15 to 20°C.

## Boiling Point:

161.5°C. (at 760 mm.)  
152 to 162°C. (at 760 mm.)  
150 to 182°C. (at 760 mm.)

## Specific Gravity:

0.9449(25/4) 0.937(37/4)  
0.9624(20/4)  
0.944 to 0.950 at 20°C.  
7.9 lbs. per gal. at 20°C.

## Refractive Index:

1.46560 at 22.6°C. 1.4654

## Viscosity (centipoises):

S.U.V. 81 at 100°F.

## Flash Point:

170°F. (open) 154°F. (closed)

## Heat of Fusion (gram-calories per g.):

4.9 at 15°C.

## Heat of Combustion (kilogram-calories

per g.-mol): 890.7 (liquid)

## Uses:

solvent for cellulose esters and ethers,  
benzyl abietate, dyes, oils, nitrocel-  
lulose, rubber, metallic soaps,  
lacquers, and printing inks  
solvent for extraction of lubricating  
oils  
disinfectants, germicides, and  
insecticides  
stabilizer homogenizer

## Solubility (grams per 100 ml.):

11.78 by weight (of water) at 20°C.  
5.67 (in water) at 15°C.  
soluble in alcohol, ether, carbon  
disulfide, benzene, and turpentine  
miscible with most organic solvents  
and oils

## Additional Data:

coefficient of expansion,  
0.00077 at 10 to 30°C.  
vapor density, 3.45

## CYCLOHEXANONE

## Synonyms:

Anon	pimelin ketone
Hexanon	ketohepta-
Sextone	methylene
pimelic ketone	

Formula:  $\text{CH}_2(\text{CH}_2)_4\text{CO}$ 

## Characteristics:

oily  
colorless to pale yellow  
acetone-like odor

Formula Weight: 98.1

Freezing Point: -45°C.

## Boiling Point:

155 to 156°C. (at 760 mm.)  
130 to 173°C. (at 760 mm.)

## Specific Gravity:

0.9478(20/4) 0.9503(15.3/4)  
7.9 lbs. per gal. at 20°C.

## Refractive Index:

1.4507 1.4524

Flash Point: 145°F. (closed)

## Uses:

solvent for basic dyes, blown oils,  
cellulose ethers and esters, crude  
rubber, fats, oils, resins, waxes,  
lacquers  
organic syntheses

## Solubility (grams per 100 ml.):

8.62 by weight (of water) at 20°C.  
2.431 (in water)  
soluble in alcohol soluble in ether  
miscible with most organic solvents

## Additional Data:

vapor density, 3.38  
coefficient of expansion,  
0.00091 at 10 to 30°C.  
dilution ratio:  
with xylene, 4.8 with mineral  
spirits, 1.0

## CYCLOHEXENE

## Synonyms:

benzene tetrahydride  
1,2,3,4-tetrahydrobenzene

Formula:  $\text{CH}_2(\text{CH}_2)_3\text{CH}:\text{CH}$

Formula Weight: 82.1

Melting Point:  $-103.7^\circ\text{C}$ .

Boiling Point:  $83.3^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8102(20/4)

Refractive Index: 1.4451 at  $22^\circ\text{C}$ .

Heat of Fusion (gram-calories per g.):  
9.6 at  $15^\circ\text{C}$ .

Heat of Combustion (kilogram-calories  
per g.-mol): 891.9 (liquid)

Uses: organic syntheses

## Solubility:

very slightly soluble in water  
very soluble in alcohol  
very soluble in ether

Additional Data: aniline equivalent, 10

## CYCLOHEXYLAMINE

## Synonyms:

aminocyclohexane hexahydroaniline

Formula:  $\text{C}_6\text{H}_{11}\text{NH}_2$

## Characteristics:

toxic fishy-amine odor

Formula Weight: 99.2

Crystallization Point:  $-17.7^\circ\text{C}$ .

## Boiling Point:

$134.5^\circ\text{C}$ . (at 760 mm.)  
 $132.0$  to  $137.5^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.8191(20/4) 0.870 to  
0.863(20/0) 0.874(15.5/15.5)

## Refractive Index:

1.4372 1.4565 at  $25^\circ\text{C}$ .

Flash Point:  $90^\circ\text{F}$ . (closed)

## Uses:

organic syntheses paint film solvent  
dye intermediate emulsifying agent  
petroleum additive  
corrosion inhibitors

## Solubility:

soluble in water, alcohol, and ether  
miscible with all common organic  
solvents including alcohols, ethers,  
esters, ketones, and aliphatic aro-  
matic and chlorinated aliphatic and  
aromatic hydrocarbons

## Additional Data:

avoid breathing vapors and contact  
with the skin  
fire point (sustained combustion),  
 $95^\circ\text{F}$ .  
vapor density, 3.42

Effect of Pressure on Boiling Point  
of Cyclohexylamine

Pressure (mm. Hg)	Boiling Point ( $^\circ\text{C}$ .)
15.0	30.5
20.0	36.4
25.0	41.3
30.0	45.1
35.0	48.1
40.0	51.4
50.0	56.0
65.0	62.4
100.0	72.0
150.0	83.0
200.0	90.9
300.0	102.5
400.0	111.6
500.0	118.9
650.0	127.9
760.0	134.5

## CYCLOHEXYLAMINE (Cont.)

Boiling Point and Composition  
of the Cyclohexylamine-Water Azeotrope

Composition of Cyclohexylamine (Weight %)	Pressure (mm. Hg)	Boiling Point (°C.)
31.0	40.0	31.7
34.0	70.0	41.9
35.9	100.0	49.0
38.0	150.0	57.3
39.3	200.0	63.6
40.9	300.0	72.7
43.0	500.0	85.3
44.2	760.0	96.4

## CYCLOHEXYL ACETATE

## Synonyms:

Adronol acetate  
cyclohexanyl acetate  
cyclohexanol acetate  
hexahydrophenol acetate  
Hexalin acetate  
hexalyn acetate  
acetic acid cyclohexanol ester

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_{11}$ 

## Characteristics:

slightly toxic  
noninflammable, nonexplosive  
odor resembling amyl acetate

Formula Weight: 142.2

## Boiling Point:

171 to 177° C. (at 760 mm.)

165 to 193° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 7 at 30° C.

## Specific Gravity:

0.966                      0.963 at 20° C.

0.985(0/4)

8.01 lbs. per gal. at 20° C.

## Flash Point:

165° F. (open)              136° F. (closed)

## Uses:

solvent for basic dyes, bitumens,  
blown oils, cellulose esters, crude  
rubber, gums, nitrocellulose and  
many resins  
apple, banana, blackberry, and rasp-  
berry flavors

## Solubility (grams per 100 ml.):

1.42 by weight (of water) at 20° C.  
insoluble in  $\infty$  (in alcohol)  
water  $\infty$  (in ether)

miscible with most lacquer solvents,  
diluent, halogenated and hydro-  
genated hydrocarbons

## Additional Data:

coefficient of expansion,  
0.00095 at 10 to 30° C.

dilution ratio:

with toluene, 2.5with petroleum naphtha, 1.2vapor density, 4.90

## CYCLOHEXYL ACRYLATE

## Synonyms:

acrylic acid cyclohexyl ester

Formula:  $\text{CH}_2\text{:CHCOOC}_6\text{H}_{11}$ 

Formula Weight: 154.2

Boiling Point: 88° C. (at 20 mm.)

Specific Gravity: 0.975(20/4)

Refractive Index: 1.456 at 24° C.

Solubility: insoluble in water

 $\infty$  (in alcohol)               $\infty$  (in ether)

## CYCLOHEXYL BENZOATE

## Synonyms:

Adronol benzoate  
benzoic acid cyclohexanol ester  
cyclohexanyl benzoate  
cyclohexyl benzoate  
hexahydrophenol benzoate  
hexalin benzoate  
hexalyn benzoate

Formula:  $\text{C}_6\text{H}_5\text{COOC}_6\text{H}_{11}$ 

Formula Weight: 204.3

Boiling Point: 160° C. (at 18 mm.)

Solubility: insoluble in water

soluble in alcohol      soluble in ether

## 2-CYCLOHEXYLCYCLOHEXANOL

## Synonyms:

2-cyclohexanol cyclohexanol  
a commercial mixture of cis and trans  
isomers

Formula:  $C_6H_{11}C_6H_{10}OH$

## Characteristics:

viscous                      mild, pleasant odor

Formula Weight: 182.3

Boiling Point: 151 to 156° C. (at 760 mm.)

Specific Gravity: 0.985(25/25)

Refractive Index: 1.502 at 25° C.

Flash Point: 270° F. (closed)

Solubility: insoluble in water

∞ (in methanol)              ∞ (in benzene)

∞ (in ether)                  ∞ (in carbon

∞ (in acetone)              tetrachloride)

Additional Data: fire point, 286° F.

## CYCLOOCTANE

Synonyms: octamethylene

Formula:  $CH_2(CH_2)_6CH_2$

Formula Weight: 112.2

Melting Point:

14.4° C.                      -9.5° C.

Boiling Point:

150 to 151° C. (at 709 mm.)

148° C. (at 760 mm.)

Specific Gravity:

0.839(20/4)                  0.835

## CYCLOPENTANE

Synonyms: pentamethylene

Formula:  $CH_2(CH_2)_3CH_2$

Formula Weight: 70.1

Melting Point:

-93.3° C.                      -93.7° C.

Boiling Point:

49 to 50° C. (at 760 mm.)

49.3° C. (at 760 mm.)

Specific Gravity:

0.745                          0.7510(20/4)

Refractive Index:

1.4039                          1.40645

Specific Heat:

0.429 (Btu. per lb. per ° F.) at 68° F.  
(liquid)

Heat of Vaporization:

167.5 (Btu. per lb.) at the boiling  
point

174.7 (Btu. per lb.) at 77° F.

Heat of Combustion (kilogram-calories  
per g.-mol): 783.6 (liquid)

Solubility:

insoluble in water              ∞ (in ether)

∞ (in alcohol)                  ∞ (in benzene)

Additional Data:

specific gravity of gas (ideal)  
(air = 1.0), 2.4211

specific gravity of liquid (in vacuo),  
0.74538(20/4)° C. 0.75048(60/60)° F

API gravity at 60° F., 57.0

liquid density (in vacuo) at 60° F.,  
6.2569

aniline point, 62.2

liquid coefficient of expansion,  
0.00072 at 32 to 104° F.

total heating values (at 77° F.)

20112 Btu. per lb.

124280 Btu. per gal. (liquid)

## CYCLOPENTANOL

Formula:  $CH_2CH_2CH_2CH_2C$

Characteristics: oily

Formula Weight: 86.1

Boiling Point: 139 to 140° C. (at 760 mm.)

Specific Gravity: 0.9488(20/4)

Refractive Index: 1.4153

Solubility:

slightly soluble in water

soluble in alcohol

## CYCLOPENTANONE

## Synonyms:

adipic ketone  
delopentamethylene

Formula:  $\text{COCH}_2\text{CH}_2\text{CH}_2\text{CH}_2$

Characteristics: oily

Formula Weight: 84.1

Melting Point:  $-58.2^\circ\text{C}$ .

Boiling Point:  $130.6^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.9480(20/4)

Refractive Index: 1.4366

## Solubility:

slightly soluble  $\infty$  (in alcohol)  
in water  $\infty$  (in ether)

## CYCLOPENTENE

Formula:  $\text{CH:CHCH}_2\text{CH}_2\text{CH}$

Formula Weight: 68.1

Melting Point:  $-93.3^\circ\text{C}$ .

Boiling Point:  $44$  to  $46^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.7743(18/4)

Refractive Index: 1.4218 at  $18^\circ\text{C}$ .

Uses: organic syntheses

## Solubility:

insoluble in water soluble in alcohol  
soluble in ether

Additional Data: aniline equivalent, 16

## CYCLOPROPANECARBOXYLIC ACID

Synonyms: ethylene acetic acid

Formula:  $\text{CH}_2\text{CH}_2\text{CHCOOH}$

Formula Weight: 86.1

Melting Point:  $18$  to  $19^\circ\text{C}$ .

Boiling Point:  $181$  to  $184^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.0885(20/4)

Refractive Index: 1.4390

## Solubility:

slightly soluble soluble in alcohol  
in water soluble in ether

m-CYMENE

## Synonyms:

3-isopropyl-1-methylbenzene  
m-isopropyltoluene  
isocymene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}(\text{CH}_3)_2$

Formula Weight: 134.2

Melting Point:  $<-25^\circ\text{C}$ .

Boiling Point:  $175.7^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8696(20/4)

Refractive Index: 1.4939 at  $17^\circ\text{C}$ .

## Uses:

organic syntheses metal polishes  
synthetic rubber

## Solubility:

insoluble in water soluble in ether  
soluble in alcohol soluble in benzene

o-CYMENE

## Synonyms:

2-isopropyl-1-methylbenzene  
o-isopropyltoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}(\text{CH}_3)_2$

Formula Weight: 134.2

Melting Point:  $-73.5^\circ\text{C}$ .

Boiling Point:  $175$  to  $176^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.876(20/4)

Refractive Index: 1.5021 at  $16^\circ\text{C}$ .

## Uses:

organic syntheses metal polishes  
synthetic rubber

## Solubility:

insoluble in water soluble in ether  
soluble in alcohol soluble in benzene

p-CYMENE

## Synonyms:

cymene

4-isopropyl-1-methylbenzene

p-isopropyltolueneFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}(\text{CH}_3)_2$ 

Characteristics: agreeable odor

Formula Weight: 134.2

Melting Point:

-68.9° C.

-73.5° C.

Boiling Point: 176 to 177° C. (at 760 mm.)

Specific Gravity: 0.8750(20/4)

Refractive Index: 1.4947 at 15° C.

Flash Point:

145° F. (open)117° F. (closed)

Heat of Fusion (gram-calories per g.):

17.2 at 15° C.

Heat of Combustion (kilogram-calories

per g.-mol): 1402.8

Uses:

organic syntheses

metal polishes

synthetic rubber

Solubility:

insoluble in water

very soluble in alcohol

soluble in ether

soluble in benzene

Additional Data:

autoignition temperature, 921° F.vapor density, 4.62

## D

## 1,3-DECADIENE

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}:\text{CHCH}:\text{CH}_2$ 

Formula Weight: 138.3

Boiling Point: 168 to 170° C. (at 760 mm.)

Specific Gravity: 0.750 at 20° C.

Formula Weight: 138.2

Melting Point: -43.3° C.

Boiling Point:

199.3° C. (at 760 mm.)

67.0° C. (at 9 mm.)

186 to 194° C. (at 760 mm.)

Specific Gravity:

0.895(18/4)

0.8927(20/4)

7.4 lbs. per gal. at 20° C.

Refractive Index:

1.467 to 1.479

1.48113

Viscosity: S.U.V. 34 at 100° F.Flash Point: 136° F. (closed)

Heat of Combustion (kilogram-calories

per g.-mol): 1502.5

Uses:

solvent and stabilizer for shoe creams  
and floor waxes

solvent in paint and lacquer industries

solvent for fats, oils, resins, rubber,

cis-DECALIN\*

## Synonyms:

bicyclo[4,4,0]-

dekalin

decane

Kelalin

decahydronaph-

naphthalene

thalene

naphthane

Formula:  $\text{C}_{10}\text{H}_{18}$ 

Characteristics:

colorless to nearly colorless

aromatic odor relatively non-residual

\* Commercial data applies to commercial solvent which is a mixture of cis- and trans-decalin.

cis-DECALIN (Cont.)

chlorinated rubber, turpentine  
substitute  
solvent for use in gas distributing  
systems

## Solubility:

insoluble (of water) soluble in alcohol  
insoluble in water soluble in ether  
miscible with most organic solvents

Additional Data: evaporation rate, slower  
than turpentine or high flash naphtha,  
faster than tetralin  
coefficient of expansion, 0.0080 at  
10 to 30°C.  
autoignition temperature, 504° F.  
vapor density, 4.76

trans-DECALIN

Synonyms: see cis-decalin

Formula:  $C_{10}H_{18}$

Characteristics: see cis-decalin

Formula Weight: 138.2

Melting Point: -30.7°C.

## Boiling Point:

185.3°C. (at 760 mm.)  
186.7°C. (at 760 mm.)  
62.0°C. (at 9 mm.)

Specific Gravity: 0.872(20/4)

Refractive Index: 1.46966

Heat of Combustion (kilogram-calories  
per g.-mol): 1499.5

Uses: see cis-decalin

Solubility: see cis-decalin

## Additional Data:

see cis-decalin  
commercial decalin may range from  
40 per cent trans-decalin to 100 per  
cent trans-decalin

## DECAMETHYLTETRASILOXANE

Formula:  $[(CH_3)_3SiOSi(CH_3)_2]_2O$

Formula Weight: 310.6

Freezing Point: -70°C.

Boiling Point: 194°C. (at 760 mm.)

Specific Gravity: 0.8536

Refractive Index: 1.3895

## Uses:

lubricating oils with wide temperature  
range  
foam suppressant for petroleum-type  
lubricating oils

## Solubility:

slightly soluble in alcohol  
slightly soluble in higher hydrocarbons  
soluble in benzene  
soluble in lower hydrocarbons

## Additional Data:

stable, maintains same viscosity for  
wide temperature range

## DECANE

## Synonyms:

n-decane decyl hydride

Formula:  $CH_3(CH_2)_8CH_3$

Formula Weight: 142.3

Melting Point: -32 to -29.7°C.

## Boiling Point:

174.0°C. (at 760 mm.)  
173.0°C. (at 760 mm.)

Specific Gravity: 0.7301(20/4)

Refractive Index: 1.41203

Inflammability Range (volume per cent  
in air):  
0.67 (lower limit) 2.6 (upper limit)

Flash Point: 115°F. (closed)

## Specific Heat:

0.523 (Btu. per lb. per °F.) at 77°F.

## Heat of Vaporization:

122.4 (Btu. per lb.) at the boiling point  
155 (Btu. per lb.) at about 77°F.

Heat of Fusion (gram-calories per g.):  
48.3 at 15°C.

Heat of Combustion (kilogram-calories  
per g.-mol): 1610.2



## 3-DECANONE (Cont.)

Formula Weight: 156.3

Boiling Point: 211°C. (at 760 mm.)

Solubility:

soluble in water      soluble in alcohol

## 4-DECANONE

Synonyms: hexyl propyl ketone

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CO}(\text{CH}_2)_5\text{CH}_3$ 

Formula Weight: 156.3

Melting Point: -9°C.

Boiling Point: 207°C. (at 760 mm.)

Specific Gravity: 0.824(20/4)

Solubility:

very slightly soluble in water  
∞ (in alcohol)      ∞ (in ether)

## 1-DECENE

Synonyms:

d or n-decylene      decene

Formula:  $\text{CH}_2:\text{CH}(\text{CH}_2)_7\text{CH}_3$ 

Formula Weight: 140.3

Melting Point:

-87°C.      -66.3°C.

Boiling Point:

172°C. (at 760 mm.)

171°C. (at 760 mm.)

Specific Gravity:

0.763(0/4)      0.7396(20/4)

0.740 at 30°C.

Refractive Index:

1.4385 at 17°C.      1.4220 at 20°C.

Uses: organic syntheses

Solubility:

insoluble in      ∞ (in alcohol)  
water      ∞ (in ether)

Additional Data:

aniline point, 114.7liquid density, 6.227 lbs. per gal. at  
60°F.cubic feet of gas per gallon of liquid,  
16.84heat of combustion of gas Btu. per lb.  
20440 gross      19080 net

liquid density, 0.751° A.P.I.

liquid weight, 6.252 lbs. per gal.

gas density, specific gravity (air = 1.  
4.839,weight in lbs. per 1000 cubic feet,  
369.4,unit volumes of gas per unit volume  
of liquid, 127air required for combustion,  
14.72 lbs. per lb. (liquid)71.40 cubic feet per cubic foot  
(perfect gas)

## DECYL ACETATE

Synonyms: acetic acid n-decyl ester

Formula:  $\text{CH}_3\text{COO}(\text{CH}_2)_9\text{CH}_3$ 

Characteristics:

fruity odor having a geranium scent  
fruity flavor resembling pineapple  
sour-sweet taste

Formula Weight: 200.3

Boiling Point:

187 to 190°C. (at 760 mm.)

125°C. (at 15 mm.)

Specific Gravity: 0.891

Uses:

apricot, honey, mirabelle plum, peach  
pineapple, and greengage flavors

Solubility:

insoluble in water      soluble in glacia  
soluble in alcohol      acetic acid  
soluble in benzene

## DECYLAMINE

Synonyms: 1-aminodecane

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{NH}_2$

**Characteristics:**

oily amine odor

Formula Weight: 157.3

**Melting Point:**

17° C. 15° C.

**Boiling Point:**220.5° C. (at 760 mm.)  
216 to 218° C. (at 760 mm.)  
215 to 221° C. (at 760 mm.)**Specific Gravity:**

0.951(0/4) 0.799(20/20)

**Refractive Index:** 1.437**Flash Point:** 210° F. (closed)**Solubility:**slightly soluble in water  
soluble in alcohol, ether, acetone,  
benzene, gasoline, methyl alcohol,  
and ethyl acetate**DECYLBENZENE**Formula:  $C_{10}H_{21}C_6H_5$ **Characteristics:**pale straw-colored  
faint aromatic odor

Formula Weight: 218.4

**Melting Point:** -50° C.

Boiling Point: 255 to 280° C. (at 760 mm.)

Specific Gravity: 0.870(20/20)

Refractive Index: 1.491

Viscosity (centipoises): 5.87 at 20° C.

Flash Point: 225° F. (closed)

**Solubility:**insoluble in water  
insoluble in methyl alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate**DECYL ETHER**

Synonyms: didecyl ether

Formula:  $(C_{10}H_{21})_2O$ 

Formula Weight: 298.5

Melting Point: 16° C.

Boiling Point: 170 to 180° C. (at 6 mm.)

Specific Gravity: 0.819(20/4)

Refractive Index: 1.4418

**tert-DECYL MERCAPTAN**Formula:  $C_{10}H_{21}SH$ 

Formula Weight: 174.3

Melting Point: &lt; -70° C.

Boiling Point: 210 to 218° C. (at 760 mm.)

Specific Gravity: 0.872(20/20)

Refractive Index: 1.469

Viscosity (centipoises): 2.07 at 20° C.

Flash Point: 190° F. (closed)

**DECYLNAPHTHALENE**Formula:  $C_{10}H_{21}C_{10}H_7$ **Characteristics:**light yellow color  
faint naphthalene odor

Formula Weight: 268.4

Melting Point: -30° C.

Boiling Point: 335 to 360° C. (at 760 mm.)

Specific Gravity: 0.938(20/20)

Refractive Index: 1.548 to 1.552

Viscosity (centipoises): 65.8 at 20° C.

Flash Point: 350° F. (closed)

**Solubility:**insoluble in water  
insoluble in methyl alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate**DECYL NITRATE**

Synonyms: 1-decanol nitrate

Formula:  $CH_3(CH_2)_9ONO_2$

## DECYL NITRATE (Cont.)

Formula Weight: 203.3

Boiling Point: 127 to 128° C. (at 11 mm.)

Specific Gravity: 0.951(0/4)

## DECYL NITRITE

Synonyms: 1-decanol nitrite

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{ONO}$ 

Formula Weight: 187.3

Boiling Point: 105 to 108° C. (at 12 mm.)

## 1-DECYNE

Synonyms:

1-decine                      octylacetylene

Formula:  $\text{CH}_3\text{C}(\text{CH}_2)_7\text{CH}_3$ 

Formula Weight: 138.3

Melting Point: -40° C.

Boiling Point: 80 to 82° C. (at 52 mm.)

Specific Gravity: 0.791

Solubility:

insoluble in	soluble in alcohol
water	soluble in ether

## 5-DECYNE

Synonyms:

5-decine                      dibutylacetylene

Formula:  $\text{C}_4\text{H}_9\text{C}\equiv\text{CC}_4\text{H}_9$ 

Formula Weight: 138.3

Boiling Point:

116° C. (at 125 mm.)

78.8° C. (at 25 mm.)

Specific Gravity: 0.7673 at 25° C.

Refractive Index: 1.4311

Solubility:

insoluble in	soluble in alcohol
water	soluble in ether

## DESOXYMESITYL OXIDE

Synonyms:

2-acetyl-1, 3, 3, 4, 4-pentamethylcyclopentene

Formula:  $\text{C}_{12}\text{H}_{20}\text{O}$ 

Formula Weight: 180.3

Boiling Point: 218 to 220° C. (at 760 mm.)

Solubility: insoluble in water

## DIACETIN

Synonyms:

glycerol diacetate      glyceryl diacetate

Formula:  $(\text{CH}_3\text{COO})_2\text{C}_3\text{H}_5\text{OH}$ 

Formula Weight: 176.2

Melting Point: 40° C.

Boiling Point:

280° C. (at 760 mm.)

250 to 253° C. (at 760 mm.)

175 to 176° C. (at 40 mm.)

Specific Gravity:

1.178(15/15)                      1.184(16/4)

Refractive Index: 1.411

Uses:

solvent for cellulose derivatives,  
glyptol resins, and shellac  
plasticizer

Solubility:

very soluble in water  
soluble in alcohol  
slightly soluble in ether  
very soluble in benzene  
insoluble in carbon disulfide

Additional Data: hygroscopic

## DIACETONE ALCOHOL

Synonyms:

diacetone                      diacetonyl alcohol

4-hydroxy-2-keto-4-methylpentane

4-hydroxy-4-methyl-2-pentanone

Formula:  $(\text{CH}_3)_2\text{COHCH}_2\text{COCH}_3$ 

Characteristics:

mild, pleasant odor    inflammable

Formula Weight: 116.2

Melting Point:

-57° C.

-47° C.

Boiling Point:

167.9° C. (at 760 mm.)

164 to 166° C. (at 760 mm.)

169.1° C. (at 760 mm.)

130 to 180° C. (at 760 mm.)

108.2° C. (at 100 mm.)

72.0° C. (at 20 mm.)

58.8° C. (at 10 mm.)

22.0° C. (at 2 mm.)

Specific Gravity:

0.931 at 25° C.

0.9406(20/20)

0.9382(20/4)

7.8 lbs. per gal. at 20° C.

Refractive Index:

1.4242

1.4300 at 9° C.

Viscosity (centipoises):

7.8 at -1.8° C.

43.6 at -30.9° C.

8.1 at -2.7° C.

128 at -42.7° C.

15.3 at -15.0° C.

298 at -49.5° C.

(supercooled)

Flash Point:

55° F. (open)

48° F. (closed)

Heat of Vaporization (gram-calories per g.): 111.0

Uses:

solvent for cellulose acetate, coating compositions, dopes, dyes, lacquers, nitrocellulose, oils, resins, tars, waxes, anti-freeze mixtures, artificial leather and silk, celluloid cements, dyeing mixtures, hydraulic compression fluid, non-grain stains, metal-cleaning compounds, wood preservatives, and photographic films

Solubility:

∞ (of water) ∞ (in alcohol)

∞ (in water) ∞ (in ether)

miscible with most organic solvents and lacquer ingredients, alcohols, aromatic and halogenated hydrocarbons

Additional Data:

water azeotrope contains 13% of the alcohol and boils at 99.6° C.

coefficient of expansion,

0.000553 per ° F.

approximate change in weight per gal.

0.0032 lbs. per ° F.

dilution ratios:

with xylene, 2.3

with mineral spirits, 0.3

vapor density, 4.00

Viscosity in Centipoises at 20° C.

% wt. of R.S. 1/2 sec. Nitrocellulose

5%

10%

15%

20%

Viscosity

52.9

382

1832

8400

### DIALLYLAMINE

Synonyms: di-2-propenylamine

Formula:  $(\text{CH}_2:\text{CHCH}_2)_2\text{NH}$

Formula Weight: 97.2

Boiling Point: 111 to 112° C. (at 760 mm.)

### DIALLYLCYANAMIDE

Synonyms: N-cyanodiallylamine

Formula:  $(\text{CH}_2:\text{CHCH}_2)_2\text{NCN}$

Formula Weight: 122.2

Boiling Point:

140 to 145° C. (at 90 mm.)

128 to 133° C. (at 57 mm.)

105 to 110° C. (at 18 mm.)

### DIALLYL PHTHALATE

Synonyms:

allyl phthalate

phthalic acid diallyl ester

Formula:  $\text{C}_6\text{H}_4(\text{COOCH}_2\text{CH}:\text{CH}_2)_2$

Characteristics: mild characteristic odor

Formula Weight: 246

Melting Point: -77° C.

Boiling Point: 158 to 195° C. (at 4 mm.)

## DIALLYL PHTHALATE (Cont.)

## Specific Gravity:

1.120(20/20)9.3 lbs. per gal. at 20° C.Refractive Index: 1.520 at 25° C.

## Surface Tension (dynes per cm.):

39.5 at 20° C.Viscosity (centipoises): 13 at 20° C.Flash Point: 330° F. (closed)

## Uses: plasticizer

## Solubility (grams per 100 ml.):

0.2% (of water)

nearly insoluble in water

insoluble in mineral oil

insoluble in glycerine

soluble in gasoline

insoluble in glycols

Additional Data: fire point, 359° F.

## DIAMYLAMINE

Synonyms: di-n-amylamineFormula:  $[\text{CH}_3(\text{CH}_2)_4]_2\text{NH}$ 

## Characteristics: amine odor

## Formula Weight: 157.3

## Boiling Point:

198 to 202° C. (at 760 mm.)

202 to 203° C. (at 745 mm.)

## Specific Gravity: 0.777(20/20)

## Refractive Index: 1.430

## Viscosity (centipoises): 1.26

## Solubility:

very slightly soluble in water

very soluble in alcohol

∞ (in ether)

soluble in acetone, benzene, gasoline,

methyl alcohol, and ethyl acetate

## DIAMYLAMINE

## Synonyms:

a mixture of various amyl amines

## Formula:

diamyl content not less than 99%

acid insolubles not more than 0.5%

sulfur not more than 0.06%

## Characteristics:

colorless to very light straw color

odor is similar to amyl amine

Boiling Point: 175 to 218° C. (at 760 mm)

## Specific Gravity:

0.77 to 0.78(20/20)6.45 lbs. per gal.Refractive Index: 1.426

## Surface Tension (dynes per cm.):

24.4 at 13° C.Viscosity (centipoises): 1.26 at 20° C.Flash Point: 158° F. (open)

## Uses:

dyes and corrosion inhibitors

flotation reagents

rubber vulcanization accelerators

solvent for some cellulose esters,

oils, and resins

## Solubility:

insoluble in water

soluble in methyl alcohol, ether,

benzene, acetone, gasoline, and

ethyl acetate

miscible with most organic solvents

## Additional Data:

pH of Aqueous Solution at 25° C.

Normality	pH
0.01	<u>11.07</u>
0.001	<u>10.89</u>

## DIAMYLBENZENE

## Synonyms: a mixture of isomers

Formula:  $(\text{C}_5\text{H}_{11})_2\text{C}_6\text{H}_4$ 

## Characteristics:

colorless to pale yellow

aromatic odor

## Formula Weight: 218.4

Melting Point: < -75° C.

Boiling Point: 255 to 280° C. (at 760 mm.)

Specific Gravity:

0.855(20/20)      0.834(60/15)

7.39 lbs. per gal.

Refractive Index: 1.483

Viscosity (centipoises):

4.72 at 20° C.      1.63 at 60° C.

3.80 at 25° C.

Flash Point: 225° F. (open)

Specific Heat (gram-calories per g.  
per °C.): 0.454

Solubility:

insoluble in water

insoluble in methyl alcohol

soluble in ether, benzene, acetone,  
gasoline, and ethyl acetate

Additional Data: coefficient of expansion,  
0.00080 per °C.

#### DIAMYLBIPHENYL

Synonyms:

diamyldiphenyl      Pentaryl B

Formula:  $C_5H_{11}C_6H_4C_6H_4C_5H_{11}$

Characteristics: straw colored

Formula Weight: 294.5

Melting Point: -30° C.

Boiling Point: 364 to 404° C. (at 760 mm.)

Specific Gravity: 0.956(20/20)

Refractive Index: 1.534

Flash Point: 340° F. (closed)

Solubility:

insoluble in water

soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

Additional Data: coefficient of expansion,  
0.00056 per °C.

#### DI-tert-AMYL CYCLOHEXANOL

Formula:  $(C_5H_{11})_2C_6H_9OH$

Formula Weight: 240.4

Freezing Point: < -5° C.

Boiling Point: 290 to 300° C. (at 760 mm.)

Specific Gravity: 0.917(20/20)

Refractive Index: 1.487 at 20° C.

Flash Point: 270° F. (closed)

Solubility:

insoluble in water

insoluble in methyl alcohol

soluble in ether, acetone, benzene,  
ethyl acetate, and gasoline

Additional Data: coefficient of expansion,  
0.00077 per °C.

#### DIAMYLENE

Synonyms:

a commercial mixture consisting  
chiefly of equal amounts of two  
decenes:

3, 5, 5-trimethyl-2-heptene and

3, 4, 5, 5-tetramethyl-2-hexene

Formula:  $C_{10}H_{20}$

Characteristics:

colorless to pale straw color

mild odor like that of turpentine

Boiling Point:

95% between 150 and 170° C.  
(at 760 mm.)

Specific Gravity:

0.77 to 0.78(20/20)  
6.42 lbs. per gal.

Flash Point: 118° F. (open)

Uses: denaturant for industrial alcohol

#### DIAMYLNAPHTHALENE

Synonyms:

Pentalene 90 (a commercial mixture  
in which secondary amyl compounds  
predominate.. The amyl groups in  
the naphthalene ring are probably in  
the  $\beta$  position.)

## DIAMYLNAPHTHALENE (Cont.)

Formula:  $C_{10}H_6(C_5H_{11})_2$ 

## Characteristics:

amber color                      viscous  
oily

Formula Weight: 268.4

Melting Point:  $-30^{\circ}C$ .Boiling Point:  $329$  to  $366^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

$0.93$  to  $0.94(20/20)$      $0.908(60/15)$   
 $7.76$  lbs. per gal.

Refractive Index:  $1.554$ 

## Viscosity (centipoises):

$89$  at  $25^{\circ}C$ .                       $9.9$  at  $60^{\circ}C$ .

Flash Point:  $315^{\circ}F$ . (open)Specific Heat (gram-calories per g.  
per  $^{\circ}C$ .):  $0.417$  (liquid)Heat of Vaporization (gram-calories  
per g.):  $50.6$ 

## Uses:

coupling agent  
intermediate in making surface active  
compounds  
plasticizer

## Solubility:

insoluble in water  
insoluble in methyl alcohol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

## Additional Data:

coefficient of expansion,  
 $0.00077$  per  $^{\circ}C$ .  
no action on copper or iron  
neutral, unsaponifiable, nontoxic, and  
thermally stable

DI-sec-AMYLPHENOLFormula:  $(C_5H_{11})_2C_6H_3OH$ 

## Characteristics:

straw color                      faint phenolic odor

Formula Weight: 234.4

Melting Point:  $10^{\circ}C$ .Boiling Point:  $280$  to  $305^{\circ}C$ . (at 760 mm.)Specific Gravity:  $0.92(20/20)$ Refractive Index:  $1.509$ Flash Point:  $260^{\circ}F$ . (closed)

## Solubility:

insoluble in water  
soluble in methyl alcohol, 10%  
potassium hydroxide, acetone,  
benzene, gasoline, ethyl acetate,  
and ether

DI-tert-AMYLPHENOL

## Synonyms:

Diamylphenol 110 (a commercial  
mixture in which the tertiary com-  
pound predominates),  
2,4-diamylphenol

Formula:  $(C_5H_{11})_2C_6H_3OH$ 

## Characteristics:

pale yellow color to brown

Formula Weight: 234.4

Boiling Point:  $275$  to  $310^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

$0.93$  to  $0.98$  at  $30^{\circ}C$ .  
 $7.75$  lbs. per gal.

Flash Point:  $260^{\circ}F$ . (open)

## Uses:

antioxidant  
plasticizer for GR-I rubber  
resin manufacture    soil fumigation

## Solubility:

insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

DI-tert-AMYLPHENOXYETHANOLFormula:  $(C_5H_{11})_2C_6H_3OCH_2CH_2OH$ 

## Characteristics:

pale straw color  
characteristic odor

Formula Weight: 278.4

Freezing Point:  $-35^{\circ}C$ .

## Boiling Point:

318 to 332° C. (at 760 mm.)

315 to 335° C. (at 760 mm.)Specific Gravity: 0.960(20/20)Refractive Index: 1.507Viscosity (centipoises): 410 at 25° C.Flash Point: 300° F. (closed)

## Solubility:

insoluble in water

soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetateAdditional Data: coefficient of expansion,  
0.00080 per ° C.

## DIAMYL PHTHALATE

## Synonyms:

amyl phthalate

phthalic acid diamyl ester

Formula:  $C_6H_4(COOC_5H_{11})_2$ 

## Characteristics:

pale yellow to brown

nearly odorless nonflammable

stable toxic

Formula Weight: 306.4

## Boiling Point:

204 to 206° C. (at 11 mm.)

247 to 255° C. (at 50 mm.)

## Specific Gravity:

1.023 at 20° C.8.25 lbs. per gal.

## Flash Point:

340° F. (open) 245° F. (closed)

## Uses:

solvent for cellulose acetate, nitro-  
cellulose, and resins  
plasticizer  
heat transfer medium

## Solubility:

miscible with most lacquer solvents,  
diluent, oils and hydrocarbons

## Additional Data:

coefficient of expansion,

0.00042 per ° F. 0.00076 per ° C.dilution ratios nitrocellulose solution  
method:with toluene, 2.2with petroleum naphtha, 2.0

## DIBENZYLAMINE

Formula:  $(C_6H_5CH_2)_2NH$ 

Formula Weight: 197.3

Melting Point: -26° C.

## Boiling Point:

300.0° C. (at 760 mm.)

268 to 271° C. (at 250 mm.)

## Specific Gravity:

1.028(25/25)1.026 at 22° C.Refractive Index: 1.57432 at 22° C.

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## DIBROMOACETYLENE

Synonyms: dibromoethyne

Formula:  $BrC \equiv CBr$ 

Characteristics: disagreeable odor

Formula Weight: 183.9

Boiling Point: 76 to 76.5° C. (at 760 mm.)

Specific Gravity: 2 ±

Uses: organic syntheses

## Solubility:

insoluble in water soluble in alcohol

soluble in ether

soluble in most organic solvents

## Additional Data:

poisonous

explodes with a trace of oxygen

decomposes in damp air forming

irritant substances

## 1,2-DIBROMOBENZENE

Synonyms: o-dibromobenzeneFormula:  $C_6H_4Br_2$ 

Characteristics: pleasant aromatic odor

Formula Weight: 235.9

Melting Point:

1.8° C.

5.6° C.

Boiling Point: 221 to 224° C. (at 760 mm.)

Specific Gravity: 1.9557(20/4)

Refractive Index: 1.6117 at 17.5° C.

Heat of Fusion (gram-calories per g.):  
12.8 at 15° C.

Uses:

motor fuels

tap-cylinder

organic syntheses

compounds

ore flotation

solvent for oils

Solubility:

insoluble in water    soluble in alcohol

very soluble in ether

miscible with most organic solvents

Additional Data: freezes at 6 to 7° C.

## 1,3-DIBROMOBENZENE

Synonyms: m-dibromobenzeneFormula:  $C_6H_4Br_2$ 

Formula Weight: 235.9

Melting Point: -6.9° C.

Boiling Point:

217 to 219.5° C. (at 760 mm.)

Specific Gravity: 1.9523(20/4)

Refractive Index: 1.6083 at 17.8° C.

Heat of Fusion (gram-calories per g.):  
13.4 at 15° C.

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## 1,2-DIBROMOBUTANE

Synonyms:

d-butylene bromided-butylene dibromideFormula:  $C_2H_5CHBrCH_2Br$ 

Characteristics: yellow color

Formula Weight: 215.9

Melting Point: -65 to -64.5° C.

Boiling Point:

166° C. (at 760 mm.)

166.3° C. (at 760 mm.)

Specific Gravity: 1.820(20/0)

Solubility:

insoluble in water    ∞ (in alcohol)

## 1,3-DIBROMOBUTANE

Formula:  $CH_3CHBrCH_2CH_2Br$ 

Formula Weight: 215.9

Boiling Point: 174 to 175° C. (at 760 mm.)

Specific Gravity: 1.807 at 18.5° C.

## 1,4-DIBROMOBUTANE

Formula:  $CH_2Br(CH_2)_2CH_2Br$ 

Formula Weight: 215.9

Melting Point: -20° C.

Boiling Point:

197.5° C. (at 760 mm.)

197 to 198° C. (at 760 mm.)

Specific Gravity: 1.819(8.5/0)

dl-2,3-DIBROMOBUTANESynonyms: β-butylene bromideFormula:  $CH_3CHBrCHBrCH_3$ 

Formula Weight: 215.9

Melting Point: -34.5° C.

Boiling Point:

157 to 158° C. (at 760 mm.)

160.5° C. (at 760 mm.)

Specific Gravity: 1.783(20/4)

Solubility: insoluble in water

**1,2-DIBROMO-1,1-DICHLOROETHANE****Synonyms:**

1,1-dichloro-1,2-dibromoethane

**Formula:**  $\text{CH}_2\text{BrCBrCl}_2$ **Formula Weight:** 256.8**Boiling Point:** 176.8° C. (at 760 mm.)**Specific Gravity:** 2.270 at 16° C.**Solubility:** insoluble in water**1,2-DIBROMO-1,2-DICHLOROETHANE****Synonyms:**

1,2-dichloro-1,2-dibromoethane

**Formula:**  $\text{CHBrClCHBrCl}$ **Formula Weight:** 256.8**Melting Point:** -26° C.**Boiling Point:** 194 to 195° C. (at 760 mm.)**Solubility:** insoluble in water**1,1-DIBROMO-2,2-DICHLOROETHANE****Synonyms:**

2,2-dichloro-1,1-dibromoethane

**Formula:**  $\text{CHBr}_2\text{CHCl}_2$ **Formula Weight:** 256.8**Boiling Point:** 195 to 200° C. (at 760 mm.)**Specific Gravity:** 2.391 at 19° C.**Solubility:** insoluble in water**1,2-DIBROMO-1,1-DICHLORO-2-FLUOROETHANE****Synonyms:**

1,1-dichloro-1,2-dibromo-2-fluoroethane

2-fluoro-1,1-dichloro-

1,2-dibromoethane

**Formula:**  $\text{CCl}_2\text{BrCHFBr}$ **Formula Weight:** 274.8**Boiling Point:** 163.5° C. (at 760 mm.)**Specific Gravity:** 2.130 at 23° C.**DIBROMODICHLOROMETHANE****Synonyms:** dichlorodibromomethane**Formula:**  $\text{CCl}_2\text{Br}_2$ **Formula Weight:** 242.8**Melting Point:** 22° C.**Boiling Point:** 135° C. (at 760 mm.)**Specific Gravity:** 2.42(25/0)**Solubility:** insoluble in water**1,1-DIBROMO-2,2-DIFLUOROETHANE****Formula:**  $\text{CHBr}_2\text{CHF}_2$ **Formula Weight:** 223.9**Boiling Point:** 107.5° C. (at 760 mm.)**Specific Gravity:** 2.312 at 20° C.**1,2-DIBROMO-2,2-DIFLUOROETHANE****Formula:**  $\text{CH}_2\text{BrCF}_2\text{Br}$ **Formula Weight:** 223.9**Melting Point:** -56.5° C.**Boiling Point:** 93° C. (at 760 mm.)**Specific Gravity:** 2.242 at 12.2° C.**1,1-DIBROMOETHANE****Synonyms:**uns-dibromoethane

ethylidene bromide

ethylidene dibromide

**Formula:**  $\text{CH}_3\text{CHBr}_2$ **Formula Weight:** 187.9**Boiling Point:** 108 to 110° C. (at 760 mm.)**Specific Gravity:** 2.089(20.5/4)**Refractive Index:** 1.51277**Solubility:**

insoluble in water

very soluble in alcohol

very soluble in ether

## 1, 2-DIBROMOETHANE

## Synonyms:

sym-dibromoethane  
ethylene bromide  
ethylene dibromide  
glycol dibromide

Formula:  $\text{CH}_2\text{BrCH}_2\text{Br}$ 

## Characteristics:

sweet characteristic chloroform-like  
odor

Formula Weight: 187.9

## Melting Point:

10°C. 9.3°C.

## Boiling Point:

131.6°C. (at 760 mm.)  
130.8°C. (at 760 mm.)  
131.4°C. (at 760 mm.)

## Specific Gravity:

2.1701(25/4) 2.172(25/25)  
2.180(20/4)  
18.07 lbs. per gal. at 25°C.

## Refractive Index:

1.53789 1.5357 at 25°C.

## Surface Tension (dynes per cm.):

38.71 at 20°C.

## Flash Point: none open or closed

## Specific Heat (gram-calories per g. per °C.):

0.17 at 13 to 106°C. (liquid)

## Heat of Vaporization (gram-calories per g.):

46.2 at the boiling point  
46.2 at 15°C.

## Heat of Fusion (joules per g.):

56.62 at 9.55°C.

## Uses:

ethyl gasoline	organic synthesis
lubricating	waterproofing
gasoline	compounds
medicines	
solvent for celluloid, fats, gums, oils,	
resins, and waxes	

## Solubility (grams per 100 ml.):

0.431 (in water) at 30°C.  
very soluble in alcohol  
 $\infty$  (in ether)  
 $\infty$  (in carbon tetrachloride)  
miscible with most organic solvents  
and thinners

## Additional Data:

volatile, toxic, and emulsifiable  
fire point, none  
dielectric constant, 1000 cycles, 5.17  
specific resistivity, ohms/cm.,  
 $2.4 \times 10^9$   
critical temperature, 309.8°C.  
critical pressure, 70.6 atm.

 $\alpha$ -DIBROMOETHYLBENZENE

## Synonyms: Alkazene 42

Formula:  $\text{C}_2\text{H}_5\text{C}_6\text{H}_3\text{Br}_2$ 

## Characteristics:

mobile liquid faint odor

Formula Weight: 264

Melting Point: < -70°C.

## Boiling Point:

258.5 to 260.6°C. (at 760 mm.)

## Specific Gravity:

1.731 to 1.74(25/25)  
14.4 lbs. per gal. at 25°C.

Refractive Index: 1.587 at 25°C.

## Viscosity (centipoises):

3.1 at 25°C. 1.7 at 60°C.

## Flash Point:

none (open) none (closed)

## Solubility (grams per 100 ml.):

insoluble in water  
50 (in methyl alcohol)  
 $\infty$  (in ether)  
 $\infty$  (in carbon tetrachloride)

## Additional Data:

noncorrosive to metals  
no fire point

## 1, 1-DIBROMOETHYLENE

## Synonyms:

1, 1-dibromoethene

uns- or d, d-dibromoethyleneFormula:  $\text{CH}_2\text{:CBr}_2$ 

Formula Weight: 185.9

Boiling Point: 91 to 92°C. (at 754 mm.)

Specific Gravity: 2.178(21/4)

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## 1, 2-DIBROMOETHYLENE

## Synonyms:

acetylene dibromide

1, 2-dibromoethene

sym- or d, β-dibromoethyleneFormula:  $\text{CHBr:CHBr}$ 

Formula Weight: 185.9

## Boiling Point:

cis 110°C. (at 754 mm.)trans 108°C. (at 760 mm.)

## Specific Gravity:

cis 2.285(17.5/4)trans 2.267(17.5/4)

## Refractive Index:

cis 1.5428trans 1.5428

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## 1, 1-DIBROMO-2-FLUOROETHANE

Synonyms: fluorodibromoethane (2; 1, 2)

Formula:  $\text{CH}_2\text{FCHBr}_2$ 

Formula Weight: 205.9

Boiling Point: 117.5°C. (at 760 mm.)

## 1, 2-DIBROMO-2-FLUOROETHANE

Synonyms: fluorodibromoethane (2; 1, 2)

Formula:  $\text{CHBrFCH}_2\text{Br}$ 

Formula Weight: 205.9

Melting Point: -54°C.

Boiling Point: 122.5°C. (at 761 mm.)

Specific Gravity: 2.257 at 17°C.

## 1, 2-DIBROMOHEXANE

Synonyms: *d*-hexylene dibromideFormula:  $\text{CH}_3(\text{CH}_2)_3\text{CHBrCH}_2\text{Br}$ 

Formula Weight: 244.0

Boiling Point: 77 to 81°C. (at 15 mm.)

Specific Gravity: 1.596 at 13.5°C.

## 1, 5-DIBROMOHEXANE

Formula:  $\text{CH}_3\text{CHBr}(\text{CH}_2)_3\text{CH}_2\text{Br}$ 

Formula Weight: 244.0

Boiling Point: 153 to 154°C. (at 100 mm.)

Specific Gravity: 1.599(20/4)

## 1, 6-DIBROMOHEXANE

Synonyms: hexamethylene dibromide

Formula:  $\text{CH}_2\text{Br}(\text{CH}_2)_4\text{CH}_2\text{Br}$ 

Formula Weight: 244.0

Boiling Point: 243°C. (at 760 mm.)

Specific Gravity: 1.595 at 15°C.

## DIBROMOMETHANE

Synonyms: methylene bromide

Formula:  $\text{CH}_2\text{Br}_2$ 

## Characteristics:

characteristic sweet odor

Formula Weight: 173.9

Melting Point: -52.8°C.

Freezing Point: &lt; -50°C.

## DIBROMOMETHANE

### DIBROMOMETHANE (Cont.)

#### Boiling Point:

95.2°C. (at 760 mm.)

95.6 to 97.4°C. (at 760 mm.)

#### Specific Gravity:

2.4953(20/4)

2.471(25/25)

#### Flash Point:

none (open)

none (closed)

#### Solubility (grams per 100 ml.):

1.15 at 20°C. (in water)

∞ (in methyl alcohol)

∞ (in ether)

∞ (in acetone)

∞ (in carbon tetrachloride)

#### Additional Data: no fire point

### 1,1-DIBROMO-2-METHYLPROPANE

#### Synonyms:

butylene isobromide

dibromoisobutane

isobutylidene bromide

Formula:  $(CH_3)_2CHCHBr_2$

Characteristics: yellow color

Formula Weight: 215.9

Melting Point: -70.3°C.

#### Boiling Point:

148 to 149°C. (at 737 mm.)

149°C. (at 760 mm.)

Specific Gravity: 1.759 at 20°C.

Refractive Index: 1.509

Uses: organic syntheses

#### Solubility:

insoluble in  
water

soluble in alcohol  
soluble in ether

### DIBROMOTROMETHANE

Formula:  $Br_2CHNO_2$

Formula Weight: 218.9

Boiling Point: 58.5 to 60°C. (at 13 mm.)

### 1,4-DIBROMOPENTANE

Formula:  $CH_3CHBrCH_2CH_2CH_2Br$

Formula Weight: 230.0

#### Boiling Point:

196.8°C. (at 746 mm.)

with decomposition

Specific Gravity: 1.622(20/4)

### 1,5-DIBROMOPENTANE

Synonyms: pentamethylene dibromide

Formula:  $CH_2Br(CH_2)_3CH_2Br$

Characteristics: aromatic odor

Formula Weight: 230.0

Melting Point: -35°C.

#### Boiling Point:

224°C. (at 760 mm.)

221°C. (at 763 mm.) with slight  
decomposition

Specific Gravity: 1.702(18/4)

Solubility: insoluble in water

### 1,1-DIBROMOPROPANE

#### Synonyms:

propylidene bromide

propylidene dibromide

Formula:  $C_3H_5CHBr_2$

Formula Weight: 201.9

Boiling Point: 130±°C. (at 760 mm.)

### 1,2-DIBROMOPROPANE

#### Synonyms:

propylene bromide

propylene dibromide

Formula:  $CH_3CHBrCH_2Br$

Formula Weight: 201.9

#### Melting Point:

-55.5°C.

< -50°C.

#### Boiling Point:

140.5°C. (at 760 mm.)

139.6 to 142.6°C. (at 760 mm.)

**Specific Gravity:**

1.933(20/4)                      1.943(25/25)  
16.20 lbs. per gal. at 25°C.

**Refractive Index:**

1.5203                      1.519 at 25°C.

**Flash Point:**

none (open)                      none (closed)

**Solubility (grams per 100 ml.):**

0.25 at 20°C. (in water)  
 0.3 at 80°C. (in water)  
 very soluble in alcohol  
 very soluble in ether  
 soluble in carbon tetrachloride  
 ∞ (in benzene)                      ∞ (in acetone)

**Additional Data:** no fire point

**1,3-DIBROMOPROPANE****Synonyms:**

trimethylene bromide  
 trimethylene dibromide

**Formula:**  $\text{CH}_2\text{BrCH}_2\text{CH}_2\text{Br}$

**Characteristics:**

highly refractive  
 sweet, suffocating odor

**Formula Weight:** 201.9

**Melting Point:**

-34.4°C.                      -33°C.

**Boiling Point:**

167.5°C. (at 760 mm.)  
166.5°C. (at 760 mm.)

**Specific Gravity:**

1.987(15/4)                      1.979(20/4)  
 1.977(25/25)  
16.49 lbs. per gal. at 25°C.

**Refractive Index:** 1.523**Viscosity (centipoises):**

1.886 at 25°C.                      1.155 at 60°C.

**Flash Point:**

none (open)                      none (closed)

**Specific Heat (gram-calories per g. per °C.):** 0.16

**Heat of Fusion:**

46.3 (gram-calories per g.)  
83 Btu. per lb.

**Uses:** manufacture of cyclopropane

**Solubility:**

0.168 at 20°C. (in water)  
 0.1 at 80°C. (in water)  
 soluble in alcohol  
 soluble in ether  
 ∞ (in carbon tetrachloride)

**Additional Data:** no fire point

**2,2-DIBROMOPROPANE**

**Synonyms:** bromacetol

**Formula:**  $(\text{CH}_3)_2\text{CBr}_2$

**Formula Weight:** 201.9

**Boiling Point:** 114.5°C. (at 740 mm.)

**Specific Gravity:** 1.7825 at 20°C.

**1,3-DIBROMO-2-PROPANOL**

**Synonyms:** 1-dibromohydrin

**Formula:**  $\text{CH}_2\text{BrCHOHCH}_2\text{Br}$

**Formula Weight:** 217.9

**Boiling Point:** 219°C. (at 760 mm.)

**Specific Gravity:** 2.11 at 18°C.

**Solubility:** insoluble in water

**2,3-DIBROMO-1-PROPANOL**

**Synonyms:** 2-dibromohydrin

**Formula:**  $\text{CH}_2\text{BrCHBrCH}_2\text{OH}$

**Formula Weight:** 217.9

**Boiling Point:**

219°C. (at 760 mm.) slight  
 decomposition

**Specific Gravity:** 2.168 at 0°C.

**1,3-DIBROMOPROPENE**

**Synonyms:**

$\alpha$ ,  $\gamma$ -dibromopropylene  
 $\beta$ -epidibromohydrin

**Formula:**  $\text{CH}_2\text{BrCH:CHBr}$

**Formula Weight:** 199.9

## 1,3-DIBROMOPROPENE (Cont.)

Melting Point:  $-52^{\circ}\text{C}$ .Boiling Point:  $155$  to  $156^{\circ}\text{C}$ . (at  $760$  mm.)Specific Gravity:  $1.995(25/4)$ 

## 2,3-DIBROMOPROPENE

## Synonyms:

 $\alpha$ -bromoallyl bromide $\beta, \gamma$ -dibromopropylene $\alpha$ -epidibromohydrinFormula:  $\text{CH}_2\text{:CBrCH}_2\text{Br}$ Formula Weight:  $199.9$ 

## Boiling Point:

 $140$  to  $142^{\circ}\text{C}$ . (at  $760$  mm.)

slight decomposition

 $75$  to  $76^{\circ}\text{C}$ . (at  $75$  mm.) $42$  to  $43^{\circ}\text{C}$ . (at  $18$  mm.)Specific Gravity:  $1.934(20/4)$ Refractive Index:  $1.5157$ 

## 1,3-DIBROMOPROPYNE

Formula:  $\text{CH}_2\text{BrC}\text{:CBr}$ Formula Weight:  $197.9$ Boiling Point:  $73$  to  $74^{\circ}\text{C}$ . (at  $30$  mm.)Specific Gravity:  $2.137$  at  $0^{\circ}\text{C}$ .

## 2,5-DIBROMOTOLUENE

Formula:  $\text{Br}_2\text{C}_6\text{H}_3\text{CH}_3$ Formula Weight:  $250.0$ Melting Point:  $< -20^{\circ}\text{C}$ .Boiling Point:  $236^{\circ}\text{C}$ . (at  $760$  mm.)Specific Gravity:  $1.813$  at  $19^{\circ}\text{C}$ .

Solubility: insoluble in water

 $\alpha, \alpha$ -DIBROMOTOLUENE

## Synonyms:

benzal bromide

benzylidene bromide

Formula:  $\text{C}_6\text{H}_5\text{CHBr}_2$ 

## Characteristics:

oily fumes

Formula Weight:  $250.0$ Boiling Point:  $140^{\circ}\text{C}$ . (at  $20$  mm.)Specific Gravity:  $1.51$  at  $15^{\circ}\text{C}$ .Refractive Index:  $1.541$ 

## Solubility:

insoluble in  $\infty$  (in alcohol)water  $\infty$  (in ether)1,1-DIBROMO-2,2,2-  
TRICHLOROETHANE

## Synonyms:

 $1, 1; 2, 2, 2$ -trichlorodibromoethaneFormula:  $\text{CHBr}_2\text{CCl}_3$ Formula Weight:  $291.2$ Boiling Point:  $93$  to  $95^{\circ}\text{C}$ . (at  $14$  mm.)Specific Gravity:  $2.317(0/4)$ 1,2-DIBROMO-1,1,2-  
TRIFLUOROETHANE

## Synonyms:

 $1, 1, 2$ -trifluoro- $1, 2$ -dibromoethaneFormula:  $\text{CBrF}_2\text{CHBrF}$ Formula Weight:  $241.9$ Boiling Point:  $76.5^{\circ}\text{C}$ . (at  $760$  mm.)Specific Gravity:  $2.254$  at  $14^{\circ}\text{C}$ .

## DIBUTOXYMETHANE

Formula:  $\text{CH}_2(\text{OC}_4\text{H}_9)_2$ Formula Weight:  $160.3$ Melting Point:  $-59.9^{\circ}\text{C}$ .Boiling Point:  $164$  to  $186^{\circ}\text{C}$ . (at  $760$  mm.)

## Specific Gravity:

 $0.838(20/20)$  $6.97$  lbs. per gal. at  $20^{\circ}\text{C}$ .Refractive Index:  $1.4062$

Flash Point: 140° F. (closed)

## Uses:

antiseptics	fungicides
deodorants	resins

N, N-DIBUTYLACETAMIDEFormula:  $\text{CH}_3\text{CON}(\text{C}_4\text{H}_9)_2$ 

Characteristics: faint odor

Formula Weight: 171.3

Melting Point: < -65° C.Boiling Point: 243 to 250° C. (at 760 mm.)Specific Gravity: 0.878(20/20)Refractive Index: 1.447 at 25° C.Viscosity (centipoises): 4.30 at 25° C.Flash Point: 225° F. (closed)Additional Data: coefficient of expansion,  
0.00074 per ° C.DIBUTYLAMINESynonyms: di-n-butylamineFormula:  $[\text{CH}_3(\text{CH}_2)_3]_2\text{NH}$ 

Characteristics: ammoniacal odor

Formula Weight: 129.2

Melting Point: < -50° C.

Boiling Point:

159 to 161° C. (at 760 mm.)154 to 167° C. (at 760 mm.)

Specific Gravity:

0.768(20/20)      0.76(20/20)0.767(20/4)6.33 lbs. per gal.Refractive Index: 1.419Surface Tension (dynes per cm.): 24.7

Viscosity (centipoises):

0.89 at 25° C.      0.51 at 60° C.Flash Point: 135° F. (open)

## Uses:

activator for vulcanization  
 accelerator  
 inhibitor in hydraulic fluids  
 formulations  
 organic syntheses

## Solubility:

$\infty$  (in water)       $\infty$  (in ether)  
 $\infty$  (in alcohol)  
 soluble in acetone, benzene, gasoline,  
 and ethyl acetate  
 miscible with most organic solvents

Additional Data: coefficient of expansion,  
0.00117 per ° C.

pH of Aqueous Solution at 25° C.

Normality	pH
0.01	.. <u>11.23</u>
0.001	.. <u>10.50</u>

DI-sec-BUTYLAMINESynonyms: sec-butylamineFormula:  $[\text{C}_2\text{H}_5(\text{CH}_3)\text{CH}]_2\text{NH}$ 

Characteristics: amine odor

Formula Weight: 129.2

Boiling Point:

132° C. (at 758 mm.)132 to 135° C. (at 760 mm.)

Specific Gravity:

0.783(0/0)      0.754(20/20)Refractive Index: 1.412Flash Point: 75° F. (open)

## Solubility:

soluble in water, methyl alcohol,  
 ether, acetone, benzene, gasoline,  
 and ethyl acetate

 $\beta$ , n-DIBUTYLAMINOETHYL ALCOHOL

Synonyms: dibutylaminoethanol

Formula:  $(\text{C}_4\text{H}_9)_2\text{NCH}_2\text{CH}_2\text{OH}$ 

Formula Weight: 173.3

Freezing Point: < -70° C.

$\beta$ , n-DIBUTYLAMINOETHYL ALCOHOL  
(Cont.)

## Boiling Point:

91 to 96°C. (at 7 mm.)

222 to 234°C. (at 760 mm.)

## Specific Gravity:

0.860(20/20)7.16 lbs. per gal.Refractive Index: 1.444

## Viscosity (centipoises):

6.50 at 25°C.1.94 at 60°C.Flash Point: 200°F. (open)

## Solubility:

insoluble in water

soluble in methyl alcohol, ether,

benzene, gasoline, acetone, and

ethyl acetate

## Additional Data:

coefficient of expansion,

0.00114 per °C.

pH of Aqueous Solution at 25°C.

Normality

pH

0.01 . . 10.810.001 . . 10.20 $\beta$ , n-DIBUTYLAMINOPROPYL ALCOHOLFormula:  $(C_4H_9)_2NCH(CH_3)CH_2OH$ 

Formula Weight: 187.3

Boiling Point: 80 to 86°C. (at 6 mm.)

 $\gamma$ , n-DIBUTYLAMINOPROPYL ALCOHOLFormula:  $(C_4H_9)_2NCH_2CH_2CH_2OH$ 

Formula Weight: 187.3

Boiling Point: 110 to 116°C. (at 8 mm.)

## n, N-DIBUTYLANILINE

Formula:  $C_6H_5N(CH_2CH_2CH_2CH_3)_2$ 

## Characteristics:

amber color

faint aromatic odor

Formula Weight: 205.3

## Boiling Point:

262.8 to 271.0°C. (at 760 mm.)

263 to 275°C. (at 760 mm.)

## Specific Gravity:

0.907

0.905(20/20)Refractive Index: 1.519Viscosity (centipoises): 5.06 at 25°C.Flash Point: 230°F. (closed)

## Solubility:

insoluble in water

insoluble in methyl alcohol

very soluble in ether, acetone, benzene,

gasoline, and ethyl acetate

Additional Data: coefficient of expansion,

0.00091 per °C.

## DIBUTYL "CARBITOL"

Synonyms: diethylene glycol dibutyl ether

Formula:  $C_4H_9O(C_2H_4O)_2C_4H_9$ 

Formula Weight: 218.3

Freezing Point: -60.2°C.

## Boiling Point:

254.6°C. (at 760 mm.)

162.0°C. (at 50 mm.)122.0°C. (at 5 mm.)Vapor Pressure: 0.02 at 20°C.

## Specific Gravity:

0.8853(20/20)7.37 lbs. per gal. at 20°C.Refractive Index: 1.4233

Absolute Viscosity (centipoises):

2.39 at 20°C.Flash Point: 260°F. (open)

## Uses:

solvent

plasticizer

lubricant

inert reaction medium

extraction medium

## Solubility:

1.4% by weight at 20° C. (of water)  
 0.3% by weight at 20° C. (in water)  
 completely miscible with acetone,  
 alcohol, 1,2-dichloroethane, ethyl  
 acetate, toluene, heptane, castor  
 oil, pine oil, and isopropyl ether

## DIBUTYL "CELLOSOLVE"

Synonyms: ethylene glycol dibutyl ether

Formula:  $C_4H_9OC_2H_4OC_4H_9$

Formula Weight: 174.3

Melting Point:  $-69.1^{\circ}C$ .

Boiling Point:

203.3° C. (at 760 mm.)

117.00° C. (at 50 mm.)

84.00° C. (at 5 mm.)

Vapor Pressure: 0.2 at 20° C.

Specific Gravity:

0.8374(20/20)

6.97 lbs. per gal. at 20° C.

Refractive Index: 1.4131

Absolute Viscosity: 1.34 at 20° C.

Flash Point: 185° F. (open)

Uses:

solvent plasticizer  
 lubricant  
 inert reaction medium  
 extraction medium

Solubility:

1.4% by weight at 20° C. (of water)  
 0.2% by weight at 20° C. (in water)  
 completely miscible with acetone,  
 alcohol, 1,2-dichloroethane, ethyl  
 acetate, toluene, heptane, castor  
 oil, pine oil, and isopropyl ether

## DIBUTYLCYANAMIDE

Formula:  $(CH_3CH_2CH_2CH_2)_2NCN$

Formula Weight: 154.3

Boiling Point: 128 to 130° C. (at 20 mm.)

Solubility:

insoluble in water soluble in ether  
 soluble in alcohol

## DIBUTYLLAURAMIDE

Synonyms: N,N-di-n-butyllauramide

Formula:  $C_{11}H_{23}CON(C_4H_9)_2$

Characteristics:

fatty acid odor straw color

Formula Weight: 311.5

Melting Point:  $-14.5^{\circ}C$ .

Boiling Point: 200 to 300° C. (at 3 mm.)

Specific Gravity: 0.860(20/20)

Refractive Index: 1.457

Viscosity (centipoises): 16.3 at 25° C.

Flash Point: 375° F. (closed)

Solubility:

insoluble in water  
 soluble in ether, methyl alcohol,  
 acetone, benzene, gasoline, and  
 ethyl acetate.

Additional Data: coefficient of expansion,  
 0.00091 per ° C.

## DIBUTYLMERCURY

Synonyms:

mercury di-n-butyl mercury dibutyl

Formula:  $(CH_3CH_2CH_2CH_2)_2Hg$

Formula Weight: 314.8

Boiling Point: 120 to 123° C. (at 28 mm.)

Specific Gravity: 1.778(20/4)

DI-(p-tert-BUTYLPHENYL)  
MONOPHENYL PHOSPHATE

Synonyms: 2-phosphen

Formula:  $(C_4H_9C_6H_4O)_2POOC_6H_5$

Characteristics: viscous

Formula Weight: 438.5

Melting Point:  $< 0^{\circ}C$ .

Boiling Point: 260 to 275° C. (at 5 mm.)

DI-(p-tert-BUTYLPHENYL)  
MONOPHENYL PHOSPHATE (Cont.)

## Specific Gravity:

1.11(25/25)9.3 lbs. per gal. at 25° C.Refractive Index: 1.540 at 25° C.

Surface Tension (dynes per cm.):

32.6 at 60° C.

Viscosity (centipoises):

580 at 25° C.35 to 45 at 60° C.

Flash Point: 482° F. (closed)

## Solubility:

insoluble in water

∞ in alcohol, carbon tetrachloride,  
benzene, toluene, petroleum diluent  
(b.p. 92 to 125° C.), naphtha VMP,  
butyl alcohol, butyl acetate, ethyl  
acetate, and ethylene dichloride

## Additional Data:

coefficient of expansion,

0.00072 at 20 to 185° C.dielectric constant (1000 cycles), 6.0,(1,000,000 cycles), 6.0power factor (1000 cycles), 1.7%,(1,000,000 cycles), 4.4%dielectric strength, >30,000 volts per  
milvolatility (100 hours at 700° C.), 0.1%resistivity, 5 x 10<sup>10</sup> ohms per cubic  
meterpour point, -10 to 0° C.fire point, >752° F.

## DIBUTYL PHTHALATE

## Synonyms:

butyl phthalate

dibutyl 1,2-benzenedicarboxylate

phthalic acid dibutyl ester

Formula:  $C_6H_4(COOC_4H_9)_2$ 

## Characteristics:

oily

aromatic odor

Formula Weight: 278.3

Melting Point: -35° C.

## Boiling Point:

340° C. (at 760 mm.)236 to 244° C. (at 50 mm.)206° C. (at 20 mm.)227 to 235° C. (at 37 mm.)

## Specific Gravity:

1.045 at 21° C.1.047 at 20° C.1.0484(20/20)8.7 lbs. per gal. at 20° C.

## Refractive Index:

1.49261.490 at 25° C.Viscosity (centipoises): 20.3 at 20° C.

## Flash Point:

335 to 340° F. (open)315° F. (closed)Specific Heat (gram-calories per g.  
per ° C.): 0.43 (liquid)

## Heat of Vaporization:

88 gram-calories per g.122.4 Btu. per lb.

## Uses:

strongest nitrocellulose solvent and  
plasticizer

airplane dopes

nitrocellulose

cements

plastics

coated papers

shatterproof glass

finger nail

textile finishes

lacquers

perfume fixative

lacquers

smokeless powder

linoleum

## Solubility:

0.46% by weight (of water) at 20° C.0.04 g. per 100 ml. (in water) at 25° C.

∞ (in alcohol)

∞ (in benzene)

∞ (in ether)

∞ (in acetone)

∞ (in chloroform)

miscible with common organic solvent  
and diluentsper cent by weight, 34% of ester in  
mineral oil and 30% of mineral oil is  
ester

## Additional Data:

vapor density, 9.58

coefficient of expansion,

0.00078 per ° C. at 20° C.0.00080 per ° C. at 55° C.

changes in specific gravity,  
0.00042 per °F. 0.000818 per °C.  
 volatility (mg./sq. cm./hr.),  
0.98 at 100°C. 148 at 190°C.  
 evaporation rate, 0.00022 g./sq.  
 cm./hr. at 100°C.  
 heat stability, good  
 fire retardation, none  
 light stability:  
   in Vinylite resin (fair)  
   in cellulose nitrate (good)  
 light fastness in nitrocellulose and  
 cellulose acetate (excellent)  
 retentivity in nitrocellulose, 100,  
 and cellulose acetate, <20  
 dilution ratios (nitrocellulose  
 solution method):  
   with toluene, 2.7  
   with petroleum naphtha, 1.7

#### DIBUTYL STEARAMIDE

Formula:  $C_{17}H_{35}CON(C_4H_9)_2$

Characteristics:

yellow                      faint acid odor

Formula Weight: 395.6

Freezing Point: 4°C.

Boiling Point: 173 to 175°C. (at 0.4 mm.)

Specific Gravity: 0.860(20/20)

Viscosity (centipoises): 36.0 at 20°C.

Flash Point: 420°F. (closed)

Solubility:

insoluble in water  
 soluble in methyl alcohol, ether,  
 acetone, benzene, gasoline, and  
 ethyl acetate

#### N,N-DIBUTYLTOLUENESULFONAMIDE

Formula:  $CH_3C_6H_4SO_3N(C_4H_9)_2$

Characteristics: light straw color

Formula Weight: 283.4

Melting Point: 100°C.

Boiling Point: 200 to 203°C. (at 10 mm.)

Specific Gravity: 1.055(20/20)

Refractive Index: 1.509

Flash Point: 330°F. (closed)

Additional Data: coefficient of expansion,  
0.00066 per °C.

#### DICHLOROACETAL

Synonyms:

1,1-dichloro-2,2-diethoxyethane

Formula:  $CH_2ClCH(OC_2H_5)_2$

Formula Weight: 187.1

Boiling Point: 183 to 184°C. (at 760 mm.)

Specific Gravity: 1.138 at 14°C.

#### DICHLOROACETALDEHYDE

Synonyms:

dichloraldehyde

dichloroethanal

2,2-dichloroethanal

Formula:  $CH_2ClCHO$

Formula Weight: 113.0

Boiling Point: 88 to 90.5°C. (at 760 mm.)

Solubility: insoluble in water

Additional Data: polymerized on standing

#### DICHLOROACETIC ACID

Synonyms:

bichloroacetic acid

chloroacetic acid

dichloroethanoic acid

Urper's liquid

Formula:  $CHCl_2COOH$

Characteristics:

characteristic pungent odor

Formula Weight: 129.0

Melting Point:

9.7°C.

-5 to 6°C.

Boiling Point:

193 to 194.4°C. (at 760 mm.)

189 to 191°C. (at 760 mm.)

## DICHLOROACETIC ACID (Cont.)

## Specific Gravity:

1.560(25/25)      1.5634(20/4)

1.560(20/4)13.0 lbs. per gal. at 20° C.

Refractive Index: 1.4659 at 22° C.

Surface Tension (dynes per cm.):

35.4 at 25.7° C. in nitrogen

Heat of Vaporization (gram-calories per g.): 77.2 at 15° C.

Heat of Fusion (gram-calories per g.):  
14.2 at 15° C.

## Uses:

organic syntheses  
intermediates and pharmaceuticals

Solubility (grams per 100 ml.):

8.63 (in water)

very soluble in alcohol

very soluble in ether

insoluble in carbon tetrachloride

## Additional Data:

irritates the skin

freezes at 11° C.

## DICHLOROACETYL CHLORIDE

Synonyms: dichloroethanoyl chloride

Formula:  $\text{CHCl}_2\text{COCl}$ 

Formula Weight: 147.4

Boiling Point: 107 to 108° C. (at 760 mm.)

Flash Point:

165° F. (open)      151° F. (closed)

Solubility:

decomposes in water

decomposes in alcohol

∞ (in ether)

Additional Data: vapor density, 5.07.

## 1,2-DICHLOROBENZENE

## Synonyms:

o-dichlorobenzene      Ortheneo-dichlorobenzolFormula:  $\text{C}_6\text{H}_4\text{Cl}_2$ 

## Characteristics:

pleasant aromatic odor

oily

colorless to slightly yellow

Formula Weight: 147.0

Melting Point:

-17.6° C.-22.5 to -10° C.

Boiling Point:

179 to 183° C. (at 760 mm.)

177 to 180° C. (at 760 mm.)

Specific Gravity:

1.3048(20/4)

1.303(25/25)

1.307(20/20)

10.84 lbs. per gal. at 25° C.

Refractive Index:

1.5518 at 22° C.

1.549 at 20° C.

Flash Point:

165° F. (open)154° F. (closed)Specific Heat (gram-calories per g. per ° C.): 0.27 (liquid)

Heat of Vaporization (gram-calories per g.):

65 at the boiling point

Heat of Fusion (gram-calories per g.):

21.0 at 15° C.

## Uses:

insecticides, fungicides, and anti-fouling paints

chemical and dye intermediate

solvent for lacquers, varnishes, gums,

resins, tars, rubbers, fats, oils,

asphalts, sulfur, and charred grease

degreasing agent

heat transfer medium

Solubility (grams per 100 ml.):

water is insoluble in this compound

0.0145 (in water) at 25° C.

slightly soluble in alcohol

very soluble in ether

∞ (in benzene)

∞ (in carbon tetrachloride)

completely miscible with most organic solvents

## Additional Data:

fire point, 284° F.

vapor density, 5.07coefficient of expansion,  
0.00083 at 10 to 30° C.

## 1, 3-DICHLOROBENZENE

## Synonyms:

m-dichlorobenzene m-dichlorobenzolFormula:  $C_6H_4Cl_2$ 

Formula Weight: 14.0

## Melting Point:

-24.8° C.

-18° C.

Boiling Point: 172 to 173° C. (at 760 mm.)

Specific Gravity: 1.288(20/4)

## Refractive Index:

1.5457 at 20.9° C. 1.548 at 17° C.

Heat of Fusion (gram-calories per g.):  
20.5 at 15° C.

## Solubility (grams per 100 ml.):

0.0123 at 25° C. (in water)

soluble in alcohol, ether, and benzene

## 1, 1-DICHLOROBUTANE

## Synonyms: butylidene dichloride

Formula:  $CH_3CH_2CH_2CHCl_2$ 

Characteristics: oily

Formula Weight: 127.0

Boiling Point: 113 to 115° C. (at 760 mm.)

## Solubility:

insoluble in water

soluble in alcohol, ether, and chloro-  
form

## 1, 2-DICHLOROBUTANE

## Synonyms: butylene chloride

Formula:  $C_2H_5CHClCH_2Cl$ 

Formula Weight: 127.0

## Boiling Point:

121 to 125° C. (at 760 mm.)

123.5° C. (at 760 mm.)

## 1, 4-DICHLOROBUTANE

## Synonyms: tetramethylene dichloride

Formula:  $CH_2ClCH_2CH_2CH_2Cl$ 

## Characteristics:

mobile liquid

mild pleasant odor

Formula Weight: 127.0

## Boiling Point:

161 to 163° C. (at 760 mm.)

155° C. (at 760 mm.)Specific Gravity: 1.141(20/4)Refractive Index: 1.4542

Flash Point: 140° F. (closed)

Uses: organic syntheses

## Solubility:

insoluble in water

soluble in most common organic  
solvents

## Additional Data:

keep away from heat and open flames

use with adequate ventilation

avoid prolonged breathing of vapor or  
contact with skin

## 2, 3-DICHLOROBUTANE

Formula:  $CH_3CHClCHClCH_3$ 

Formula Weight: 127.0

## Melting Point:

-80.4° C.

-112° C.

## Boiling Point:

115.9 to 123° C. (at 760 mm.)

## Specific Gravity:

1.105(20/4)9.20 lbs. per gal. at 20° C.

## Flash Point:

194° F. (open)

90° F. (open)

70° F. (closed)

Heat of Vaporization (gram-calories  
per g.): 65.0 at 15° C.

## Uses:

organic syntheses

paint and varnish removers

solvent for dyes, fats, gums, resins,  
rubber, and waxes

## 2,3-DICHLOROBUTANE (Cont.)

## Additional Data:

kauri-butanol number, 97.8the commercial product contains some  
1,2-dichlorobutane

## 1,3-DICHLORO-2-BUTENE

Synonyms: DCB

Formula:  $\text{CH}_2\text{ClCH:CClCH}_3$ 

## Characteristics:

straw color                      pungent odor

Formula Weight: 125

## Boiling Point:

125 to 130° C. (at 760 mm.)52 to 56° C. (at 50 mm.)Specific Gravity: 1.130 to 1.160(20/4)Refractive Index: 1.472 to 1.477

Uses: organic syntheses

## Solubility:

insoluble in water  
soluble in alcohol, ether, acetone,  
carbon tetrachloride, and benzene

## Additional Data:

the commercial product contains  
aromatic solvents and is purified by  
fractional distillation

## 1,1-DICHLORO-2,2-DIFLUOROETHANE

Formula:  $\text{CHCl}_2\text{CHF}_2$ 

Formula Weight: 135.0

Boiling Point: 60° C. (at 760 mm.)Specific Gravity: 1.494 at 17° C.

## Solubility:

insoluble in                       $\infty$  (in alcohol)  
water                               $\infty$  (in ether)

## 2,3-DICHLORODIOXANE

Formula:  $\text{O}(\text{CHCl})_2\text{O}(\text{CH}_2)_2$ 

Characteristics: oily

Formula Weight: 157.0

Boiling Point: 88 to 89° C. (at 19 mm.)x-DICHLORODIPHENYLMETHANEFormula:  $(\text{C}_{12}\text{H}_8\text{Cl}_2)\text{CH}_2$ 

Characteristics: pale yellow

Formula Weight: 237.0

Boiling Point: 165 to 170° C. (at 7.5 mm.)Specific Gravity: 1.27(25/20)Refractive Index: 1.594 at 25° C.

## Solubility:

insoluble in water  
50 g. per 100 g. (in methyl alcohol)  
 $\infty$  (in ether, carbon tetrachloride,  
acetone, and benzene)

## 1,1-DICHLOROETHANE

## Synonyms:

uns-dichloroethane  
ethylidene chloride  
ethylidene dichlorideFormula:  $\text{CH}_3\text{CHCl}_2$ 

## Characteristics:

oily  
sweet odor and taste like chloroform

Formula Weight: 99.0

Melting Point: -96.7° C.

## Boiling Point:

56 to 57° C. (at 760 mm.)57 to 59° C. (at 760 mm.)

## Specific Gravity:

1.170(25/25)                      1.175(20/4)Refractive Index: 1.4166Flash Point: 200° F. (closed)Heat of Vaporization (gram-calories  
per g.): 76.7 at 15° C.Heat of Combustion (kilogram-calories  
per mole): 267.1 (liquid)

## Solubility (grams per 100 ml.):

0.7 (in water) at 0° C.0.55 (in water) at 20° C. $\infty$  (in alcohol)                       $\infty$  (in benzene) $\infty$  (in ether)                       $\infty$  (in carbon $\infty$  (in acetone)                      tetrachloride)

## Additional Data:

critical temperature, 261.5° C.  
critical pressure, 50.0 atm.

## 1,2-DICHLOROETHANE

## Synonyms:

sym-dichloroethane  
Dutch liquid  
ethylene chloride  
ethylene dichloride  
glycol dichloride

Formula:  $\text{CH}_2\text{ClCH}_2\text{Cl}$

## Characteristics:

oily  
ethereal pleasant odor  
sweet taste

Formula Weight: 99.0

Melting Point: -35.3° C.

## Boiling Point:

83.7° C. (at 760 mm.)  
82 to 84° C. (at 760 mm.)

## Specific Gravity:

1.256(20/4)                      1.259(20/4)  
10.5 lbs. per gal. at 20° C.

Refractive Index: 1.4448

## Viscosity (centipoises):

1.001344 (vapor) at 0° C.  
1.132 (liquid) at 0° C.  
0.838 (liquid) at 20° C.  
0.652 (liquid) at 40° C.  
0.479 (liquid) at 70° C.

## Inflammability Range (volume per cent in air):

6.2 (lower limit)              15.9 (upper limit)

## Flash Point:

65 to 70° F. (open)    56° F. (closed)

## Specific Heat (gram-calories per g. per ° C.):

0.308 at 20° C. (liquid)  
0.255 at 97.1° C. (vapor)

## Heat of Vaporization:

77.3 (gram-calories per g.) at the  
boiling point  
139.1 (Btu. per lb.)

## Heat of Formation (kilogram-calories per mole):

37.6 (liquid)                      29.3 (vapor)

## Uses:

solvent for fats, gums, oils, resins,  
rubber, and wax  
manufacture of acetyl cellulose  
inhalation anesthesia  
tobacco extracts              cleaning agent  
organic syntheses              extracting agent  
dye intermediates              fumigant

## Solubility (grams per 100 ml.):

0.15 (of water)              0.9 (in water)  
very soluble in alcohol  
∞ (in ether)                      ∞ (in carbon  
∞ (in chloroform)              tetrachloride)  
soluble in common organic solvents

## Additional Data:

azeotrope with water boils at 71.8° C.  
and contains 8.2% of water  
weight of pure vapor, 4320 mg./ℓ.  
thermal conductivity of liquid,  
0.0825 at 20° C.  
evaporation rate (ether = 100), 27  
dielectric constant,  
(liquid), 10.45 at 20° C.  
(vapor), 1.00481 at 120° C.  
electrical conductivity,  
< 1 x 10<sup>-8</sup> mhos  
critical temperature, 288.4° C.  
critical pressure, 53.0 atm.  
fire point, 82° F.  
specific resistivity,  
9.0 x 10<sup>6</sup> ohms/cm.  
coefficient of expansion,  
0.000645 per ° F.,  
0.00116 at 10 to 30° C.  
autoignition temperature, 775° F.  
steam distillation point, 1 atm. 71.4° C.  
solvent:  
water ratio, by weight, 11.3:1  
vapor density (g./ℓ.), 3.38  
specific gravity (air = 1.00), 3.4  
b. p., 760 mm. (lb./cu. ft.), 0.211  
slightly hydrolyzed by water  
dilution ratios:  
acetone . . . . . 8.6  
solvatone . . . . . 6.8  
ethyl acetate . . . . . 5.4  
isopropyl acetate . . . . . 4.3

## 1,2-DICHLOROETHANE (Cont.)

methyl Cellosolve . . . . .	9.2
butyl acetate . . . . .	3.7
Cellosolve . . . . .	7.6
butyl propionate . . . . .	2.7
Cellosolve acetate . . . . .	4.2
Pentacetate . . . . .	3.5
butyl Cellosolve . . . . .	4.5

cis-sym-1,2-DICHLOROETHYLENE

## Synonyms:

acetylene dichloride  
sym-dichloroethylene  
 $\alpha$ ,  $\beta$ -dichloroethylene  
 1,2-dichloroethene

Formula:  $\text{CHCl:CHCl}$ 

Formula Weight: 97.0

Melting Point:  $-80.5^{\circ}\text{C}$ .Boiling Point:  $60.1^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.291(15/4)

Refractive Index: 1.4519 at  $15^{\circ}\text{C}$ .Flash Point:  $43^{\circ}\text{F}$ . (closed)

## Uses:

solvent for cellulose acetate, gums,  
 oils, resins, rubber, shellac, waxes,  
 lacquers, perfumes, and organic  
 syntheses

## Solubility:

insoluble in	$\infty$ (in alcohol)
water	$\infty$ (in ether)

## Additional Data:

critical temperature,  $271.0^{\circ}\text{C}$ .  
 critical pressure, 57.9 atm.

trans-sym-1,2-DICHLOROETHYLENE

## Synonyms:

acetylene dichloride  
 1,2-dichloroethene  
sym-dichloroethylene  
 $\alpha$ ,  $\beta$ -dichloroethylene

Formula:  $\text{CHCl:CHCl}$ 

Formula Weight: 97.0

Melting Point:  $-50^{\circ}\text{C}$ .Boiling Point:  $48.4^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.265(14/4)

Refractive Index: 1.4490 at  $15^{\circ}\text{C}$ .

## Solubility:

insoluble in	$\infty$ (in alcohol)
water	$\infty$ (in ether)

## Additional Data:

critical temperature,  $243.3^{\circ}\text{C}$ .  
 critical pressure, 54.5 atm.

## 1,1-DICHLOROETHYLENE

## Synonyms:

1,1-dichloroethene  
uns-dichloroethylene  
 $\alpha$ ,  $\alpha$ -dichloroethylene  
 vinylidene chloride

Formula:  $\text{CH}_2:\text{CCl}_2$ 

Formula Weight: 97.0

Melting Point:  $-122.5^{\circ}\text{C}$ .

## Boiling Point:

$31.7^{\circ}\text{C}$ . (at 760 mm.)  
 $37^{\circ}\text{C}$ . (at 760 mm.)

## Specific Gravity:

1.250(15/4)	1.2099 at $25^{\circ}\text{C}$ .
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Refractive Index: 1.4228 at  $25^{\circ}\text{C}$ .

Inflammability Range (volume per cent in air):

5.6 (lower limit)	13 (upper limit)
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Solubility: insoluble in water

## 2,2-DICHLOROETHYL ALCOHOL

Synonyms:  $\beta$ ,  $\beta$ -dichloro-1-ethanolFormula:  $\text{CHCl}_2\text{CH}_2\text{OH}$ 

Formula Weight: 115.0

Boiling Point:  $146^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.145(15/4)

## Solubility:

slightly soluble in water  
 soluble in alcohol  
 soluble in ether

## 1,2-DICHLOROETHYL ETHYL ETHER

## Synonyms:

dichloroether

1,2-dichloro-1-ethoxyethane

 $\alpha$ ,  $\beta$ -dichloroethyl ethyl ether $\alpha$ ,  $\beta$ -dichloroethyl etherFormula:  $\text{CH}_2\text{ClCHClOC}_2\text{H}_5$ 

Formula Weight: 193.0

Boiling Point: 140 to 145°C. (at 760 mm.)

Specific Gravity: 1.174(23/4)

## Solubility:

very soluble in alcohol

very soluble in ether

## 1,3-DICHLORO-2,4-HEXADIENE

## Synonyms:

a commercial mixture of the cis and trans isomers

## Characteristics:

oily

pale straw color

## Boiling Point:

cis 80 to 82°C. (at 17 mm.)trans 60 to 62°C. (at 17 mm.)Specific Gravity: 1.1456(20/4)

## Refractive Index:

cis 1.525trans 1.520

## Uses:

lachrymator

organic syntheses

## Solubility:

insoluble in water

soluble in hydrocarbon solvents

## Additional Data:

the commercial product is stabilized  
with 0.1% acetic anhydride

## 2,2-DICHLORO-1-iodoethane

Formula:  $\text{CH}_2\text{ICHCl}_2$ 

Formula Weight: 224.9

Boiling Point: 171 to 172°C. (at 760 mm.)

Specific Gravity: 2.219

Solubility: insoluble in water

## DICHLOROIODOMETHANE

Formula:  $\text{CHCl}_2\text{I}$ 

Formula Weight: 210.9

Boiling Point: 131°C. (at 760 mm.)

Specific Gravity: 2.403 at 21.5°C.

Solubility: insoluble in water

## DICHLOROMETHANE

## Synonyms:

methylene bichloride

methylene chloride

Formula:  $\text{CH}_2\text{Cl}_2$ 

## Characteristics:

volatile

poisonous

Formula Weight: 84.9

Melting Point: -96.7°C.

## Boiling Point:

40 to 42°C. (at 760 mm.)

40.7°C. (at 760 mm.)

## Specific Gravity:

1.336(20/4)

1.320(25/25)

11.0 lbs. per gal. at 20°C.

## Refractive Index:

1.4237

1.421 at 25°C.

Surface Tension (dynes per cm.): 28.2

Viscosity (centipoises): 0.425

Specific Heat (gram-calories per g.  
per °C.):

0.29 at 15 to 40°C. (liquid)

0.155 at 40°C. (vapor)

## Heat of Vaporization:

79.8 (gram-calories per g.)142.0 Btu. at the boiling point

## Uses:

solvent for alkaloids, bitumens, crude  
rubber, various organic compounds,  
and waxes

cleaner

oil extraction

degreasing agent

refrigerant

dewaxing

spotting agent

fire extinguishing

compositions

## DICHLOROMETHANE (Cont.)

Solubility (grams per 100 ml.):

0.198 (of water) at 25° C.

1.32 (in water) at 25° C.

2 (in water) at 20° C.

∞ (in alcohol) ∞ (in benzene)

∞ (in ether) ∞ (in methyl

∞ (in carbon alcohol)

tetrachloride) ∞ (in V.M.P.

∞ (in acetone) naphtha)

## 1, 4-DICHLORO-2-METHYLBUTANE

Synonyms: dichloropentane

Formula:  $\text{CH}_2\text{ClCH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 141.0

Boiling Point: 170 to 172° C. (at 760 mm.)

Solubility:

insoluble in ∞ (in alcohol)  
water ∞ (in ether)

## 2, 3-DICHLORO-2-METHYLBUTANE

Synonyms: dichloropentane

Formula:  $(\text{CH}_3)_2\text{CClCHClCH}_3$ 

Formula Weight: 141.0

Boiling Point: 130 to 135° C. (at 760 mm.)

Specific Gravity: 1.068(15/4)

Solubility:

insoluble in ∞ (in alcohol)  
water ∞ (in ether)

## 2, 4-DICHLORO-2-METHYLBUTANE

Synonyms: dichloropentane

Formula:  $(\text{CH}_3)_2\text{CClCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 141.0

Boiling Point:

152 to 154° C. (at 760 mm.)

slight decomposition

Specific Gravity: 1.065(20/4)

Solubility:

insoluble in ∞ (in alcohol)  
water ∞ (in ether)

## 3, 4-DICHLORO-2-METHYLBUTANE

Synonyms: dichloropentane

Formula:  $(\text{CH}_3)_2\text{CHCHClCH}_2\text{Cl}$ 

Formula Weight: 141.0

Boiling Point: 143 to 145° C. (at 760 mm.)

Specific Gravity: 1.092 at 17.5° C.

Solubility:

insoluble in ∞ (in alcohol)  
water ∞ (in ether)

## 4, 4-DICHLORO-2-METHYLBUTANE

Synonyms: dichloropentane

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CHCl}_2$ 

Formula Weight: 141.0

Boiling Point: 130° C. (at 760 mm.)

Specific Gravity: 1.05 at 24° C.

Solubility:

insoluble in ∞ (in alcohol)  
water ∞ (in ether)

## 1, 1-DICHLORO-2-METHYLPROPANE

Synonyms: dichloroisobutane

Formula:  $(\text{CH}_3)_2\text{CHCHCl}_2$ 

Formula Weight: 127.0

Boiling Point:

103 to 105° C. (at 760 mm.) decomposes

Specific Gravity: 1.011 at 12° C.

## 1, 3-DICHLORO-2-METHYLPROPANE

Synonyms: dichloroisobutane

Formula:  $(\text{CH}_2\text{Cl})_2\text{CHCH}_3$ 

Formula Weight: 127.0

Boiling Point: 135 to 139° C. (at 760 mm.)

Specific Gravity: 1.138 at 20° C.

## 1, 2-DICHLORO-2-METHYLPROPANE

Synonyms: dichloroisobutane

Formula:  $(\text{CH}_3)_2\text{CClCH}_2\text{Cl}$



## 1,4-DICHLOROPENTANE (Cont.)

Boiling Point: 58 to 60° C. (at 15 mm.)

## Solubility:

insoluble in	∞ (in alcohol)
water	∞ (in ether)

## 1, 5-DICHLOROPENTANE

## Synonyms:

amylene chloride  
pentamethylene dichloride  
pentamethylene chloride

Formula:  $\text{CH}_2\text{Cl}(\text{CH}_2)_3\text{CH}_2\text{Cl}$ 

## Characteristics:

mobile  
mild, pleasant odor

Formula Weight: 141.0

Melting Point: -72.8° C.

Boiling Point: 178 to 181° C. (at 760 mm.)

## Specific Gravity:

1.0940(25/4)	1.102(20/4)
--------------	-------------

Refractive Index: 1.4563Flash Point: >80° F. (open)

Uses: organic syntheses

## Solubility:

insoluble in water  
soluble in alcohol, ether, chloroform,  
benzene, petroleum ether and most  
common organic solvents

## 2, 3-DICHLOROPENTANE

Formula:  $\text{C}_2\text{H}_5(\text{CHCl})_2\text{CH}_3$ 

Formula Weight: 141.0

Boiling Point: 138 to 139° C. (at 760 mm.)

## Solubility:

insoluble in	∞ (in alcohol)
water	∞ (in ether)

## 2, 4-DICHLOROPENTANE

Formula:  $(\text{CH}_3\text{CHCl})_2\text{CH}_2$ 

Formula Weight: 141.0

Boiling Point: 147 to 150° C. (at 760 mm.)

Specific Gravity: 1.063 at 18° C.

## Solubility:

insoluble in	∞ (in alcohol)
water	∞ (in ether)

## DICHLOROPENTANES

## Synonyms:

dichloropentanes 14  
a commercial product containing 40%  
of amylene dichloride and 60% of  
practically all other dichloropentane  
and dichloroisopentane

Formula:  $\text{C}_5\text{H}_{10}\text{Cl}_2$ 

Characteristics: clear to light yellow

Formula Weight: 141.0

Melting Point: <-50° C.

## Boiling Point:

130 to 200° C. (at 760 mm.) 95%

## Specific Gravity:

1.06 to 1.08(20/20)	1.04(60/15)
8.94 lbs. per gal.	

Refractive Index: 1.448

Surface Tension (dynes per cm.):

31.8 at 25° C.

Viscosity (centipoises):

1.6 at 25° C.	0.65 at 60° C.
---------------	----------------

Flash Point: 106° F. (open)Specific Heat (gram-calories per g.  
per ° C.): 0.369 (liquid)Heat of Vaporization (gram-calories  
per g.): 68.5

## Uses:

insecticide                      metal degreasing  
paint and varnish removers  
synthetic rubber dipping cements  
solvent for greases, oils, resins, and  
rubbers

## Solubility:

insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

## Additional Data:

acidity, not over 0.38 mg.  
 potassium hydroxide per g.  
 fire point (open cup), 130° F.  
 kauri butanol value, 67 ml.  
 coefficient of expansion,  
0.00063 per °C.  
 average chlorine content, 48%

## Evaporation Rate at 109° F.

%	Minutes
25 . . . . .	<u>3.83</u>
50 . . . . .	<u>8.0</u>
75 . . . . .	<u>14.2</u>
100 . . . . .	<u>90.0</u>

o, o'-DICHLOROPHENYL  
PHENYL PHOSPHATE

Synonyms: Phosphen-4

Formula:  $C_6H_5OPO(ClC_6H_4O)_2$ 

Formula Weight: 395.2

Melting Point: &lt;0° C.

Boiling Point: 255 to 257° C. (at 5 mm.)

Specific Gravity: 1.34(25/25)

## Solubility:

insoluble in water    ∞ (in benzene)  
 soluble in alcohol    ∞ (in carbon  
                                  tetrachloride)

## DICHLOROPHENYL PHOSPHINE

## Synonyms:

phenyl dichlorophosphine  
 phosphenyl chloride

Formula:  $C_6H_5PCl_2$ 

Characteristics: fumes

Formula Weight: 179.0

Boiling Point: 224.6° C. (at 760 mm.)

Specific Gravity: 1.319 at 20° C.

## Solubility: decomposes in water

∞ (in benzene)  
 ∞ (in carbon disulfide)

## x-DICHLOROPHENYL XENYL ETHER

Formula:  $C_{18}H_{12}OCl_2$ 

## Characteristics:

light straw-colored viscous

Formula Weight: 315.2

Melting Point: &lt;0° C.

Boiling Point: 222° C. (at 10 mm.)Specific Gravity: 1.233(25/25)

## Viscosity (centipoises):

556 at 25° C.                      24.5 at 60° C.

Flash Point: 399° F. (closed)

## Solubility (grams per 100 ml.):

insoluble in water  
 14 (in methyl alcohol)  
 >100 in ether, acetone, benzene, and  
 carbon tetrachloride

## 1, 1-DICHLOROPROPANE

## Synonyms:

*a, a*-dichloropropane  
 propylidene chloride  
 propylidene dichloride

Formula:  $CH_3CH_2CHCl_2$ 

Formula Weight: 113.0

Boiling Point: 87° C. (at 760 mm.)

Specific Gravity: 1.143 at 10° C.

Refractive Index: 1.4467

## Solubility:

very slightly soluble in water  
 soluble in alcohol

## 1, 2-DICHLOROPROPANE

## Synonyms:

*a, β*-dichloropropane  
 propylene chloride  
 propylene dichloride

Formula:  $CH_3CHClCH_2Cl$ 

## Characteristics:

sweetish odor is similar to that of  
 ethylene dichloride

## 1, 2-DICHLOROPROPANE (Cont.)

Formula Weight: 113.0

Melting Point:  $< -70^{\circ}\text{C.}$ 

Boiling Point:

96.8 $^{\circ}\text{C.}$  (at 760 mm.)95.4 $^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity:

1.1583(20/20) 1.1656 at 14 $^{\circ}\text{C.}$ 9.7 lbs. per gal. at 20 $^{\circ}\text{C.}$ 

Refractive Index:

1.4388 1.4371 at 25 $^{\circ}\text{C.}$ 

Surface Tension (dynes per cm.):

31.4 at 25 $^{\circ}\text{C.}$ Viscosity (poises): 0.00865 at 20 $^{\circ}\text{C.}$ Inflammability Range (volume per cent  
in air):

3.4 (lower limit) 14.5 (upper limit)

Flash Point:

65 $^{\circ}\text{F.}$  (open) 59 $^{\circ}\text{F.}$  (closed)Specific Heat (gram-calories per g.  
per  $^{\circ}\text{C.}$ ): 0.22 (liquid)Heat of Vaporization (gram-calories  
per g.): 68.1 at the boiling point

Uses:

dry cleaning fluids  
metal degreasing agents  
organic syntheses  
fumigant  
scouring compounds  
spotting agents  
solvent for fats, gums, oils, resins,  
and waxes  
paint and varnish removers

Solubility (grams per 100 ml.):

0.06 (of water) at 20 $^{\circ}\text{C.}$ 0.27 (in water) at 20 $^{\circ}\text{C.}$ 

very soluble in alcohol

very soluble in ether

 $\infty$  (in benzene) $\infty$  (in carbon tetrachloride)

miscible with most organic solvents

Additional Data:

fire point, 100.4 $^{\circ}\text{F.}$ 

vapor density, 3.89

specific resistivity (ohms/cm.),  
2.5  $\times 10^8$ autoignition temperature, 1035 $^{\circ}\text{F.}$ 

dielectric constant,

85.8 kilocycles

8.925 mhos at 26 $^{\circ}\text{C.}$ 

coefficient of expansion,

0.001108 to 20 $^{\circ}\text{C.}$ ,0.001153 to 55 $^{\circ}\text{C.}$ 

## 1, 3-DICHLOROPROPANE

Synonyms:

trimethylene chloride

trimethylene dichloride

Formula:  $\text{CH}_2\text{ClCH}_2\text{CH}_2\text{Cl}$ 

Formula Weight: 113.0

Boiling Point:

125 $^{\circ}\text{C.}$  (at 760 mm.)119 $^{\circ}\text{C.}$  (at 740 mm.)Specific Gravity: 1.201 at 15 $^{\circ}\text{C.}$ 

Refractive Index: 1.4469

Solubility (grams per 100 ml.):

0.287 at 30 $^{\circ}\text{C.}$  (in water)

very soluble in alcohol

very soluble in ether

## 2, 2-DICHLOROPROPANE

Synonyms:

acetone chloride

acetone dichloride

isopropylidene chloride

Formula:  $\text{CH}_3\text{CCl}_2\text{CH}_3$ 

Formula Weight: 113.0

Melting Point: -34.6 $^{\circ}\text{C.}$ Boiling Point: 69.7 $^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity: 1.093(20/20)

Refractive Index: 1.4471

Solubility:

insoluble in water soluble in alcohol

 $\infty$  (in ether) $\infty$  (in carbon disulfide)

## 1, 3-DICHLORO-2-PROPANOL

## Synonyms:

*d*-dichlorohydrin  
 dichlorohydroxypropanl  
sym- or 1, 3-dichloroisopropyl alcohol  
 1, 3-dichloropropane-2-ol  
 glycerindichlorohydrin  
sym- or *d*-glycerol dichlorohydrin  
 glyceryl dichlorohydrin  
*d*-propenyl dichlorohydrin  
 the commercial product is a mixture  
 of 1, 3-dichloro-2-hydroxypropane  
 with minor amounts of 1, 2-dichloro-  
 3-hydroxypropane

Formula:  $\text{CH}_2\text{ClCHOHCH}_2\text{Cl}$

## Characteristics:

highly viscous  
 slight chloroform-like odor

Formula Weight: 129.0

Melting Point:  $-20^\circ\text{C}$ .

## Boiling Point:

$174.3^\circ\text{C}$ . (at 760 mm.)  
 $114.8^\circ\text{C}$ . (at 100 mm.)  
 $93^\circ\text{C}$ . (at 40 mm.)  
 $78^\circ\text{C}$ . (at 20 mm.)  
 $52^\circ\text{C}$ . (at 5 mm.)  
 $28^\circ\text{C}$ . (at 1 mm.)

## Specific Gravity:

1.367(20/4)      1.36 to 1.39  
 1.3506(17/4)

## Refractive Index:

1.480245 at  $17^\circ\text{C}$ .      1.47 to 1.48

Flash Point:  $165^\circ\text{F}$ . (open)

## Uses:

celluloid cements  
 lacquers  
 photographic lacquers  
 organic syntheses  
 paints  
 varnishes  
 solvent mixtures  
 solvent for benzyl abietate, cellulose  
 acetate, ethylcellulose, cellulose  
 nitrate, gums, and resins

## Solubility (grams per 100 ml.):

11 at  $19^\circ\text{C}$ ., 19 at  $70^\circ\text{C}$ ., 12 at  $20^\circ\text{C}$ .,  
 (in water)  
 $\infty$  (in alcohol)       $\infty$  (in ether)  
 miscible with most organic solvents  
 and vegetable oils

## Additional Data:

unstable      non-flammable

## 2, 3-DICHLORO-1-PROPANOL

Synonyms:  $\beta$ -glycerol dichlorohydrin

Formula:  $\text{CH}_2\text{ClCHClCH}_2\text{OH}$

Formula Weight: 129.0

Boiling Point:  $182$  to  $183^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.362(20/4)

Solubility (grams per 100 ml.):  
 14.5 (in water)

## 1, 1-DICHLORO-2-PROPANONE

## Synonyms:

*d*-uns-dichloroacetone  
 dichloromethyl methyl ketone

Formula:  $\text{CH}_2\text{ClCOCH}_3$

Formula Weight: 127.0

Boiling Point:  $120^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.234 at  $15^\circ\text{C}$ .

## Solubility:

very slightly soluble in water  
 soluble in alcohol  
 very soluble in ether

## 1, 1-DICHLORO-1-PROPENE

Synonyms: *d*, *d*-dichloropropylene

Formula:  $\text{CH}_3\text{CH:CCl}_2$

Formula Weight: 110.0

Boiling Point:  $78^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.176(19.5/0)

Solubility: insoluble in water

## 1, 2-DICHLORO-1-PROPENE

## Synonyms:

allylene dichloride

 $\alpha$ ,  $\beta$ -dichloropropyleneFormula:  $\text{CH}_3\text{CCl}:\text{CHCl}$ 

Formula Weight: 110.0

## Boiling Point:

75° C. (at 760 mm.)

84 to 86° C. (at 760 mm.)

Solubility: insoluble in water

Uses: see 1, 3-dichloro-1-propene

## 1, 3-DICHLORO-1-PROPENE

## Synonyms:

 $\gamma$ -chloroallyl chloride $\alpha$ ,  $\gamma$ -dichloropropylene $\beta$ -epidichlorohydrinFormula:  $\text{CH}_2\text{ClCH}:\text{CHCl}$ 

Characteristics: chloroform-like odor

Formula Weight: 110.0

Boiling Point: 106 to 109° C. (at 760 mm.)

## Specific Gravity:

1.233 at 17° C.

1.220 at 25° C.

Refractive Index: 1.4735 at 22° C.

## Uses:

with 1, 2-dichloro-1-propene as a soil fumigant, particularly against nematodes

## Additional Data:

lower boiling stereoisomer:

boiling point, 104.3° C. (at 760 mm.)

specific gravity, 1.224(20/4)

refractive index, 1.4682

higher boiling stereoisomer:

boiling point, 112° C. (at 760 mm.)

specific gravity, 1.217(20/4)

refractive index, 1.4730

## 2, 3-DICHLORO-1-PROPENE

## Synonyms:

 $\alpha$ -chloroallyl chloride $\beta$ ,  $\gamma$ -dichloropropyleneFormula:  $\text{CH}_2:\text{CClCH}_2\text{Cl}$ 

Formula Weight: 110.0

Boiling Point: 94° C. (at 760 mm.)

## Specific Gravity:

1.205(20/4)

1.236(0/4)

## Solubility:

insoluble in

 $\infty$  (in alcohol)

water

 $\infty$  (in ether) $\alpha$ ,  $\alpha$ -DICHLOROPROPIONIC ACIDFormula:  $\text{CH}_3\text{CCl}_2\text{COOH}$ 

Formula Weight: 143.0

Boiling Point: 185 to 190° C. (at 760 mm.)

## Solubility:

very soluble in water

very soluble in alcohol

 $\alpha$ ,  $\alpha$ -DICHLOROPROPIONITRILEFormula:  $\text{CH}_3\text{CCl}_2\text{CN}$ 

Formula Weight: 124.0

Boiling Point: 105° C. (at 760 mm.)

Specific Gravity: 1.431 at 15° C.

## Solubility:

insoluble in

 $\infty$  (in alcohol)

water

 $\infty$  (in ether)

## 2, 3-DICHLOROPROPYL ACETATE

## Synonyms:

acetodichlorohydrin

 $\beta$ ,  $\gamma$ -dichloropropyl acetateFormula:  $\text{CH}_3\text{COOCH}_2\text{CHClCH}_2\text{Cl}$ 

Formula Weight: 171.0

Boiling Point: 191 to 192° C. (at 760 mm.)

Specific Gravity: 1.168 at 15° C.

## 2, 3-DICHLOROPROPYL NITRATE

## Synonyms: dichloronitrohydrin

Formula:  $\text{CH}_2\text{ClCHClCH}_2\text{NO}_3$ 

Formula Weight: 174.0

Boiling Point: 180.0° C. (at 760 mm.)

Specific Gravity: 1.3 at 7° C.

### 2, 5-DICHLOROTHIOPHENE

Formula: ClC1=CC(S)=CC1Cl

Formula Weight: 153.0

Boiling Point: 157 to 162° C. (at 760 mm.)

Specific Gravity: 1.443(20/4)

Refractive Index: 1.5626

Uses: organic syntheses

Additional Data: 95+ % pure

### 2, 4-DICHLOROTOLUENE

Formula: CH3C6H3Cl2

Formula Weight: 161.0

Freezing Point: -13.0° C.

Boiling Point: 200 to 202° C. (at 760 mm.)

Uses:

high boiling solvent

organic synthesis of dyes, medicines,  
pharmaceuticals, and other organic  
chemicals

### 3, 4-DICHLOROTOLUENE

Formula: CH3C6H3Cl2

Formula Weight: 161.0

Freezing Point: -14.0° C.

Boiling Point: 208 to 213° C. (at 760 mm.)

Uses: see 2, 4-DICHLOROTOLUENE

### d, d-DICHLOROTOLUENE

Synonyms:

benzal chloride

benzylene chloride

benzyl bi- or dichloride

chlorobenzal

Formula: C6H5CHCl2

Characteristics:

oily

faint aromatic odor

colorless to yellow

Formula Weight: 161.0

Melting Point: -16.1° C.

Freezing Point: -17° C.

Boiling Point:

207 to 214° C. (at 760 mm.)

203° C. (at 756 mm.)

200 to 235° C. (at 760 mm.)

Specific Gravity:

1.295 at 16° C.

1.279(15.5/15.5)

1.2557 at 14° C.

Refractive Index: 1.5502

Uses:

manufacture of dyes and benzaldehyde

Solubility:

insoluble in

∞ (in alcohol)

water

∞ (in ether)

### DICYCLOHEXYLAMINE

Formula: (C6H11)2NH

Characteristics:

faint fishy amine odor

toxic

Formula Weight: 181.3

Freezing Point: -0.1

Boiling Point:

252 to 258° C. (at 760 mm.)

254 to 256° C. (at 745 mm.)

255.8° C. (at 760 mm.)

214.5° C. (at 300 mm.)

200° C. (at 200 mm.)

174.4° C. (at 100 mm.)

154.3° C. (at 50 mm.)

135.4° C. (at 25 mm.)

121° C. (at 11 mm.)

99.3° C. (at 4 mm.)

83° C. (at 1 mm.)

Specific Gravity:

0.925 at 18° C.

0.9104(25/25)

Refractive Index: 1.4823 at 25° C.

DICYCLOHEXYLAMINE (Cont.)

Flash Point: >200° F. (open)

Uses:

organic syntheses  
manufacture of cutting oils and  
extreme pressure lubricants

Solubility (grams per 100 ml.):

0.16 at 28° C. (in water)  
very soluble in alcohol  
∞ (in ether)  
soluble in benzene  
soluble in all common solvents  
miscible with cyclohexylamine

Additional Data:

vapor density, 6.27  
avoid breathing vapors and contact  
with skin  
fire point (sustained combustion),  
>230° F.  
does not form an azeotrope mixture on  
distillation with water

Effect of Pressure on Boiling Point  
of Dicyclohexylamine

Pressure (mm. Hg)	Boiling Point (° C.)
0.7	81.8
2.9	93.5
3.7	99.3
6.7	109.7
11.2	120.9
25.0	135.4
35.0	144.4
50.0	154.3
75.0	166.9
100.0	174.4
200.0	199.0
300.0	214.5
500.0	236.2
760.0	255.8

DIETHANOLAMINE

Synonyms:

diethylolamine  
β, β-dihydroxydiethylamine  
di-2-hydroxyethylamine  
2, 2'-iminodiethanol  
iminoethyl alcohol

Formula:  $(\text{CH}_2\text{OHCH}_2)_2\text{NH}$

Characteristics:

viscous faintly colored

Formula Weight: 105.1

Melting Point: 28° C.

Boiling Point:

268° C. (at 760 mm.)  
270° C. (at 748 mm.)  
269.1° C. (at 760 mm.)

Vapor Pressure (mm. Hg):

<0.01 at 20° C.

Specific Gravity:

1.0966(20/4) 1.0985(20/20)  
9.1 lbs. per gal. at 20° C.

Refractive Index: 1.4776

Flash Point:

280° F. (open) 305° F. (closed)

Uses:

absorption of acidic gases  
organic syntheses  
gas purification  
emulsifying, moistening and softening  
agent

Solubility:

∞ (in water) ∞ (in alcohol)  
very slightly soluble in ether  
slightly soluble in benzene  
miscible with most organic solvents

Additional Data:

autoignition temperature, 122.4° F.  
vapor density, 3.65  
pH 0.1 N solution, 8.88

1, 3-DIETHOXYBENZENE

Synonyms:

m-diethoxybenzene  
resorcinal diethyl ether

Formula:  $(\text{C}_2\text{H}_5\text{O})_2\text{C}_6\text{H}_4$

Formula Weight: 166.2

Melting Point: 12.4° C.

Boiling Point:

234 to 235° C. (at 756 mm.)

## Solubility:

insoluble in water      soluble in alcohol  
                                       soluble in ether

N, N-DIETHYLACETAMIDE

Synonyms: acetyl diethyl amine

Formula:  $\text{CH}_3\text{CON}(\text{C}_2\text{H}_5)_2$ 

Characteristics: faint odor

Formula Weight: 115.2

Melting Point:  $< -65^\circ \text{C}$ .

Boiling Point:

185 to  $186^\circ \text{C}$ . (at 760 mm.)183 to  $187^\circ \text{C}$ . (at 760 mm.)

Specific Gravity:

0.925 at  $8.5^\circ \text{C}$ .      0.916 at  $20^\circ \text{C}$ .Refractive Index: 1.433Viscosity (centipoises): 2.11 at  $25^\circ \text{C}$ .

Additional Data:

coefficient of expansion,  
0.00091 per  $^\circ \text{C}$ .

## DIETHYL ACETOACETATE

Synonyms:

 $\alpha, \alpha$ -diethylacetoacetic acid ethyl ester

diethyl acetoacetic ester

ethyl 2, 2-diethyl-3-oxybutanoate

Formula:  $\text{CH}_3\text{COC}(\text{C}_2\text{H}_5)_2\text{COOC}_2\text{H}_5$ 

Characteristics: yellow

Formula Weight: 186.2

Boiling Point:

211 to  $218^\circ \text{C}$ . (at 760 mm.) decomposes

Specific Gravity: 0.965(25/4)

Refractive Index: 1.4327 at  $17.2^\circ \text{C}$ .Flash Point:  $170^\circ \text{F}$ . (closed)

## DIETHYL ACETONEDICARBOXYLATE

Formula:  $\text{CO}(\text{CH}_2\text{COOC}_2\text{H}_5)_2$ 

Characteristics: oily

Formula Weight: 202.2

Boiling Point:  $250^\circ \text{C}$ . (at 760 mm.)

Specific Gravity: 1.113(20/4)

Solubility:

very slightly soluble in water

 $\infty$  (in alcohol)       $\infty$  (in ether)

## DIETHYL ACETYLMALONATE

Synonyms:

acetyl diethylmalonate

acetyl ethylmalonate

ethyl acetylmalonate

Formula:  $\text{CH}_3\text{COCH}(\text{COOC}_2\text{H}_5)_2$ 

Formula Weight: 202.2

Boiling Point:

 $240^\circ \text{C}$ . (at 760 mm.) $120^\circ \text{C}$ . (at 17 mm.)

Specific Gravity:

1.083(26/5)

1.080 at  $23^\circ \text{C}$ .

Solubility:

soluble in dilute alkali

soluble in sodium carbonate solution

DIETHYL  $\alpha, \beta$ -ACETYLSUCCINATE

Synonyms:

acetylsuccinic acid diethyl ester

diethyl acetylbutanedioate

ethyl acetylsuccinate

Formula:

 $\text{CH}_3\text{COCH}(\text{COOC}_2\text{H}_5)\text{CH}_2\text{COOC}_2\text{H}_5$ 

Formula Weight: 116.2

Boiling Point:

 $254$  to  $256^\circ \text{C}$ . (at 760 mm.)

decomposes

Specific Gravity:

1.080(25/25)

1.081(20/4)

Refractive Index: 1.438 at  $16^\circ \text{C}$ .

Solubility:

insoluble in water      soluble in alcohol

## DIETHYL ALLYLMALONATE

## Synonyms:

allylmalonic acid diethyl ester  
 diethoxy (2-propenyl) propanedioate  
 diethyl 3-butene-1, 1-dicarboxylate  
 ethyl allylmalonate

Formula:  $C_3H_5CH(COOC_2H_5)_2$

Formula Weight: 200.2

## Boiling Point:

222 to 223°C. (at 760 mm.)  
 110 to 112°C. (at 14 mm.)

## Specific Gravity:

1.006(25/25) 1.0148 at 16°C.

## Solubility:

insoluble in water soluble in alcohol  
 soluble in ether

## DIETHYLAMINE

Formula:  $(C_2H_5)_2NH$

Characteristics: strongly alkaline

Formula Weight: 73.0

## Melting Point:

-50 to -38.9°C. -50°C.

## Boiling Point:

55.5°C. (at 760 mm.)  
53 to 59.5°C. (at 760 mm.)

## Specific Gravity:

0.712(15/15) 0.711(18/4)  
5.89 lbs. per gal.

Refractive Index: 1.3873 at 18°C.

Surface Tension (dynes per cm.):

16.4 at 56°C. in air

Viscosity (centipoises):

0.346 at 25°C. 0.367 at 25°C.

Flash Point: <0°F. (open)

Heat of Vaporization:

91.03 gram-calories per g. at 58°C.  
 716.9 kilogram-calories

Heat of Combustion (gram-calories  
 per g.):

9882 (liquid) 9995 (gas)

## Uses:

selective solvent in petroleum and  
 vegetable oil refining and for many  
 organic compounds  
 activator for natural and synthetic  
 rubbers  
 vulcanization sizing compounds  
 dyes surface active  
 medicines agents  
 emulsifiers

Solubility (grams per 100 ml.):

81.5 at 44°C. (in water)  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
 soluble in gasoline, benzene, acetone,  
 and ethyl acetate

## Additional Data:

should be stored in tightly closed  
 container  
 critical pressure, 36.6 atm.  
 critical temperature, 223.3°C.  
 heat of solution in water at room  
 temperature 8220 calories per mole  
 of solute at infinite solution  
 dissociation constant at 25°C.,  
 $1.26 \times 10^{-3}$   
 forms a hydrate with one molecule of  
 water, m.p. -19°C.

## pH of Aqueous Solution

Normality	pH
1.0	12.43
0.5	12.31
0.1	12.04
0.05	11.86
0.01	11.05
0.001	10.75

## 2-DIETHYLAMINOETHANOL

## Synonyms:

$\beta$ -diethylaminoethanol  
 $\beta$ -diethylaminoethyl alcohol  
 2-hydroxytriethylamine

Formula:  $(C_2H_5)_2NHCH_2CH_2OH$

Characteristics:

hygroscopic amine-like odor

Formula Weight: 117.2

Freezing Point: <-70°C.

**Boiling Point:**

160 to 163° C. (at 760 mm.)

100° C. (at 80 mm.)

42 to 44° C. (at 8 mm.)

158 to 163° C. (at 760 mm.)**Vapor Pressure:** 1.4 at 20° C.**Specific Gravity:**

0.885(20/20)                      0.884(20/4)

0.8601(25/25)

7.4 lbs. per gal. at 20° C.**Refractive Index:**1.4400 at 25° C.                      1.4417**Viscosity (centipoises):**3.53 at 20° C.                      1.50 at 60° C.4.05 at 25° C.**Flash Point:** 140° F. (open)**Heat of Vaporization:** 165 Btu. per lb.**Uses:**

emulsifying agents	soaps
lubricants	surface active
pharmaceuticals	agents

**Solubility:**

∞ (of water)                      ∞ (in water)  
 very soluble in alcohol  
 very soluble in ether  
 soluble in acetone, gasoline, benzene,  
 and ethyl acetate

**Additional Data:**

water azeotrope boils at 99° C. and  
 contains 76% of water

pH of 25° solution, 11.9 at 25° C.

coefficient of expansion,

0.0012 per ° C.

pH of Aqueous Solution of  
 2-Diethylaminoethanol (H-electrode)

Normality	pH
1.0	<u>11.86</u>
0.5	<u>11.71</u>
0.1	<u>11.33</u>
0.05	<u>11.22</u>
0.01	<u>10.88</u>
0.001	<u>10.30</u>

**1-DIETHYLAMINOGLYCEROL****Synonyms:**d-diethylamino-2,3-propanediol**Formula:**  $(C_2H_5)_2NHCH_2CHOHCH_2OH$ **Characteristics:** syrupy**Formula Weight:** 147.2**Boiling Point:** 233 to 235° C. (at 760 mm.)**Solubility:**

soluble in water, alcohol, ether, and  
 chloroform

**m-DIETHYLAMINOPHENETOLE****Synonyms:** diethyl-m-phenetidine**Formula:**  $C_2H_5OC_6H_4N(C_2H_5)_2$ **Characteristics:** oily**Formula Weight:** 193.3**Boiling Point:** 286° C. (at 760 mm.)**Solubility:**

insoluble in water  
 soluble in alcohol  
 soluble in acetic acid

**β-DIETHYLAMINOPROPYL ALCOHOL****Formula:**  $(C_2H_5)_2NCH(CH_3)CH_2OH$ **Formula Weight:** 131.2**Boiling Point:** 61 to 63° C. (at 25 mm.)**γ-DIETHYLAMINOPROPYL ALCOHOL****Formula:**  $(C_2H_5)_2NCH_2CH_2CH_2OH$ **Formula Weight:** 131.2**Boiling Point:** 189.5° C. (at 760 mm.)**Solubility:** very soluble in water**DIETHYL AMYLMALONATE****Synonyms:**

amylmalonic acid diethyl ester  
 ethyl amylmalonate

## DIETHYL AMYLMALONATE (Cont.)

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}(\text{COOC}_2\text{H}_5)_2$ 

Formula Weight: 230.3

Boiling Point: 121 to 123°C. (at 6 mm.)

Refractive Index: 1.4253

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

N-DIETHYLANILINE

## Synonyms:

N, N-diethylanilineN-phenyldiethylamineFormula:  $(\text{C}_2\text{H}_5)_2\text{NC}_6\text{H}_5$ 

## Characteristics:

oily

colorless to yellow-brown

pungent, characteristic aniline odor

Formula Weight: 149.2

Melting Point: -38.8 to -34.4°C.

## Boiling Point:

215 to 216°C. (at 760 mm.)

212 to 216°C. (at 760 mm.)

## Specific Gravity:

0.9351(20/4)

7.8 lbs. per gal. at 20°C.

Refractive Index: 1.5421

## Surface Tension (dynes per cm.):

34.7 at 15°C.

24.9 at 110°C.

34.2 at 20°C.

Viscosity (centipoises): 1.95 at 25°C.

Flash Point: 220° F. (closed)

## Uses:

dyes

pharmaceuticals

organic syntheses

## Solubility (grams per 100 ml.):

1.4 at 12°C. (in water)

soluble in alcohol, ether, chloroform,  
carbon tetrachloride, methyl alcohol,  
acetone, benzene, gasoline, and ethyl  
acetate

miscible with most organic solvents

## Additional Data:

poisonous

volatile in steam

inflammable

## 1, 2-DIETHYLBENZENE

Synonyms: o-diethylbenzeneFormula:  $(\text{C}_2\text{H}_5)_2\text{C}_6\text{H}_4$ 

Formula Weight: 134.2

Melting Point: &lt; -20°C.

## Boiling Point:

176.5 to 184.5°C. (at 760 mm.)

## Specific Gravity:

0.881(20/4)

0.8662(18/4)

## Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## 1, 3-DIETHYLBENZENE

Synonyms: m-diethylbenzeneFormula:  $(\text{C}_2\text{H}_5)_2\text{C}_6\text{H}_4$ 

Formula Weight: 134.2

Melting Point: -84.2°C.

Boiling Point: 181 to 182°C. (at 760 mm.)

Specific Gravity: 0.8602(20/4)

Refractive Index: 1.4955

## Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## 1, 4-DIETHYLBENZENE

Synonyms: p-diethylbenzeneFormula:  $(\text{C}_2\text{H}_5)_2\text{C}_6\text{H}_4$ 

Formula Weight: 134.2

Melting Point: -35°C.

Boiling Point: 182 to 183°C. (at 760 mm.)

## Specific Gravity:

0.865(20/4)

0.8675(14/4)

Refractive Index: 1.4978 at 14°C.

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

x-DIETHYLBENZENE

## Synonyms:

a commercial mixture of isomers

Formula:  $(C_2H_5)_2C_6H_4$

## Characteristics:

mobile liquid  
characteristic aromatic odor

Formula Weight: 134.2

Melting Point:  $< -70^\circ C$ .

Boiling Point:  $181.2^\circ C$ . (at 760 mm.)

## Specific Gravity:

0.868(25/25)

7.22 lbs. per gal. at  $25^\circ C$ .

Refractive Index:  $1.493$  at  $25^\circ C$ .

## Viscosity (centipoises):

0.84 at  $25^\circ C$ .

0.6 at  $60^\circ C$ .

Flash Point:  $138^\circ F$ . (closed)

Specific Heat (gram-calories per g.  
per  $^\circ C$ .):  $0.38$  (liquid)

Heat of Vaporization (gram-calories  
per g.):  $72.2$  at the boiling point

Uses: general commercial solvent

## Solubility:

insoluble in water  
soluble in alcohol, ether, benzene,  
and carbon tetrachloride

## Additional Data:

fire point,  $147^\circ C$ .

dielectric constant (1000 cycles),  $2.2$

dielectric strength, 0.1" gap,

22,000 volts

power factor (1000 cycles),  $< 0.05\%$

specific resistivity, D.C.,

$4.8 \times 10^{12}$  ohms per cm.

## DIETHYL BENZYL MALONATE

## Synonyms:

benzylmalonic acid diethyl ester  
diethyl benzylpropanedioate  
ethyl benzylmalonate

Formula:  $C_6H_5CH_2CH(COOC_2H_5)_2$

Formula Weight: 250.3

Boiling Point:  $296$  to  $300^\circ C$ . (at 760 mm.)

Specific Gravity: 1.077(15/15)

Solubility: insoluble in water

## DIETHYL BROMOMALEATE

Formula:  $CH:CHBr(COOC_2H_5)_2$

Formula Weight: 251.1

Boiling Point:  $256^\circ C$ . (at 760 mm.)

Specific Gravity: 1.410 at  $17.5^\circ C$ .

## DIETHYL BROMOMALONATE

## Synonyms:

bromomalonic acid diethyl ester  
diethyl bromopropanedioate  
ethyl bromomalonate

Formula:  $CHBr(COOC_2H_5)_2$

Formula Weight: 239.1

Melting Point:  $< -54^\circ C$ .

## Boiling Point:

$233$  to  $235^\circ C$ . (at 760 mm.) decomposes

$125$  to  $127^\circ C$ . (at 15 mm.)

Specific Gravity: 1.4022(25/4)

## Solubility:

insoluble in                       $\infty$  (in alcohol)  
water                                 $\infty$  (in ether)

N, N'-DIETHYL 1, 3-BUTANEDIAMINE

Synonyms: 1, 3-bis-ethylaminobutane

Formula:  $C_2H_5NHCH_2CH_2CHN(C_2H_5)CH_3$

Characteristics: amine odor

Formula Weight: 144.3

Boiling Point:  $179$  to  $185^\circ C$ . (at 760 mm.)

Specific Gravity:  $0.818$ (20/20)

Refractive Index:  $1.439$

Flash Point:  $115^\circ F$ . (open)

N,N DIETHYL 1,3-BUTANEDIAMINE  
(Cont.)

## Solubility:

soluble in water, methyl alcohol, ether,  
acetone, benzene, gasoline, and ethyl  
acetate

## DIETHYL BUTYLMALONATE

## Synonyms:

butylmalonic acid diethyl ester  
ethyl n-butylmalonate

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 216.3

## Boiling Point:

235 to 240° C. (at 760 mm.)  
130 to 135° C. (at 20 mm.)

Refractive Index: 1.425

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

DIETHYL sec-BUTYLMALONATE

## Synonyms:

sec-butylmalonic acid diethyl ester  
ethyl sec-butylmalonate

Formula:  $\text{C}_2\text{H}_5(\text{CH}_3)\text{CHCH}(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 216.3

## Boiling Point:

224 to 225° C. (at 760 mm.)  
233 to 234° C. (at 774 mm.)  
94 to 95° C. (at 3 mm.)

Specific Gravity: 0.988 at 15° C.

Refractive Index: 1.4248

## Solubility:

very slightly soluble in water  
very soluble in alcohol  
very soluble in ether

## DIETHYL "CARBITOL"

## Synonyms:

bis- $\beta$ -ethoxyethyl ether  
diethylene glycol diethyl ether  
1-ethoxy-2-( $\beta$ -ethoxyethoxy) ethane

Formula:  $(\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2)_2\text{O}$

Characteristics: nearly odorless

Formula Weight: 162.2

Freezing Point: -44.3° C.

## Boiling Point:

188.9° C. (at 760 mm.)  
180 to 190° C. (at 760 mm.)  
107.0° C. (at 50 mm.)  
73.0° C. (at 5 mm.)

Vapor Pressure (mm. Hg):

0.4 at 20° C.      1.0 at 30° C.

Specific Gravity:

0.907(20/4)      0.9082(20/20)  
7.56 lbs. per gal. at 20° C.

Refractive Index: 1.4115

Absolute Viscosity: 1.4

Flash Point: 180° F. (open)

## Uses:

mutual solvent for water and oil  
solvent for nitrocellulose, and resins  
high boiling reaction medium  
brushing lacquers  
organic syntheses  
inert reaction or extraction medium  
lubricant      plasticizer

## Solubility:

soluble in common organic solvents  
 $\infty$  (of water)       $\infty$  (in water)  
very soluble in ether  
completely miscible with alcohol,  
acetone, 1,2-dichloroethane, ethyl  
acetone, toluene, heptane, castor oil  
pine oil, and isopropyl ether

## Additional Data:

coefficient of expansion,  
0.00106 at 10 to 30° C.  
dilution ratio:  
with xylene, 1.4  
with mineral spirits, 0.5

## DIETHYL "CELLOSOLVE"

## Synonyms:

diethoxyethane  
ethylene glycol diethyl ether

Formula:  $C_2H_5OC_2H_4OC_2H_5$

Formula Weight: 118.2

Freezing Point: -74.00° C.

Boiling Point:

121.4° C. (at 760 mm.)

117 to 129° C. (at 760 mm.)

49.00° C. (at 50 mm.)

20.00° C. (at 5 mm.)

Vapor Pressure (mm. Hg):

9.4 at 20° C.

22 at 30° C.

Specific Gravity:

0.8417(20/20)

7.01 lbs. per gal. at 20° C.

Refractive Index: 1.3922

Absolute Viscosity: 0.65 at 20° C.

Flash Point: 80 to 95° F. (open)

Uses:

commercial solvent

mutual solvent for water and oil

inert reaction or extraction medium

lubricant

plasticizer

Solubility (grams per 100 ml.):

3.4 (of water)

21 at 20° C. (in water)

completely miscible with alcohol,

acetone, 1,2-dichloroethane, ethyl

acetate, toluene, heptane, castor oil,

pine oil, and isopropyl ether

Additional Data:

coefficient of expansion,

0.00120 at 10 to 30° C.

dilution ratio:

with xylene, 0.4

with mineral spirits, 0.2

#### DIETHYL CHLOROMALEATE

Formula:  $CH:CCl(COOC_2H_5)_2$

Formula Weight: 206.6

Boiling Point:

235° C. (at 760 mm.) slight decomposition

Specific Gravity: 1.191(25/4)

#### DIETHYL CITRACONATE

Formula:  $CH_3C_2H(CO_2C_2H_5)_2$

Formula Weight: 186.2

Boiling Point: 230.3° C. (at 760 mm.)

Specific Gravity: 1.062(20/4)

#### DIETHYL CYANAMIDE

Synonyms:

cyanodiethylamine

Formula:  $(C_2H_5)NCN$

Formula Weight: 98.2

Boiling Point:

188 to 189° C. (at 748 mm.)

190° C. (at 760 mm.)

68° C. (at 10 mm.)

Specific Gravity: 0.854(20/4)

Refractive Index: 1.4126 at 48° C.

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

decomposes in hydrochloric acid

#### DIETHYL CHLOROFUMARATE

Formula:  $CH:CCl(COOC_2H_5)_2$

Formula Weight: 206.6

Boiling Point:

250° C. (at 760 mm.) slight decomposition

Specific Gravity: 1.189(20/20)

#### N,N-DIETHYL CYCLOHEXYLAMINE

Synonyms: hexahydro-diethylaniline

Formula:  $\underline{CH_2(CH_2)_4}CHN(C_2H_5)_2$

Formula Weight: 155.3

Boiling Point: 193° C. (at 760 mm.)

Specific Gravity: 0.872(0/0)

## DIETHYL DIBENZYLMALONATE

## Synonyms:

dibenzylmalonic acid diethyl ester  
diethyl 1,3-diphenyl-2,2-propanedi-  
carboxylate

Formula:  $(C_6H_5CH_2)_2C(COOC_2H_5)_2$

## Characteristics:

viscous                      oily

Formula Weight: 340.4

Melting Point: 13 to 14°C.

Boiling Point: 243 to 246°C. (at 18 mm.)

Specific Gravity: 1.093(20/4)

## Solubility:

soluble in alcohol      soluble in ether

## DIETHYL DIBROMOMALEATE

## Synonyms:

dibromomaleic acid diethyl ester

Formula:  $(:CBr_2COOC_2H_5)_2$

Formula Weight: 330.0

Boiling Point: 170 to 175°C. (at 15 mm.)

Specific Gravity: 1.698(25/25)

## DIETHYL DIBROMOMALONATE

## Synonyms:

dibromomalonic acid diethyl ester

Formula:  $Br_2C(COOC_2H_5)_2$

Formula Weight: 318.0

## Boiling Point:

250 to 256°C. (at 760 mm.)  
slight decomposition

## DIETHYL DIBUTYLMALONATE

## Synonyms:

dibutylmalonic acid diethyl ester

Formula:  $(C_4H_9)_2C(COOC_2H_5)_2$

Formula Weight: 272.4

Boiling Point: 153 to 154°C. (at 14 mm.)

## DIETHYL DIETHYLMALONATE

## Synonyms:

diethyl diethylpropanedioate  
diethylmalonic acid diethyl ester

Formula:  $(C_2H_5)_2C(COOC_2H_5)_2$

Formula Weight: 216.3

Boiling Point: 223 to 230°C. (at 760 mm.)

Specific Gravity: 0.985(20/4)

Refractive Index: 1.4252 at 16.6°C.

## Solubility:

insoluble in	∞ (in alcohol)
water	∞ (in ether)

## DIETHYL DIMETHYLMALONATE

## Synonyms:

diethyl dimethylpropanedioate  
dimethylmalonic acid diethyl ester

Formula:  $(CH_3)_2C(COOC_2H_5)_2$

Formula Weight: 188.2

## Boiling Point:

196.2 to 196.7°C. (at 760 mm.)

## Specific Gravity:

0.994(25/25)	0.9910(25/4)
--------------	--------------

Refractive Index: 1.4105 at 24.1°C.

## Solubility:

insoluble in	∞ (in alcohol)
water	∞ (in ether)

## DIETHYL DISULFIDE

Formula:  $C_2H_5SSC_2H_5$

Characteristics: oily

Formula Weight: 122.2

## Boiling Point:

152.8 to 153.4°C. (at 760 mm.)

Specific Gravity: 0.993(20/4)

## Solubility:

very slightly soluble in water

## DIETHYL DITHIOCARBONATE

## Synonyms:

carbonyl disulfethyl  
 dithiolcarbonic acid diethyl ester  
 ethyldithiolcarbonate  
 ethyl ethoxymethane thionolthiolate  
 ethyl xanthate  
 ethyl xanthogenate

## Formula:

 $\text{CO}(\text{SC}_2\text{H}_5)_2, \text{C}_2\text{H}_5\text{OCSSC}_2\text{H}_5$ 

## Characteristics:

yellow                      garlic-like odor

Formula Weight: 150.3

## Boiling Point:

198.6 to 200.1° C. (at 760 mm.)

Specific Gravity: 1.048 at 15° C.

## Solubility:

insoluble in water  
 soluble in alcohol and ether

## DIETHYLENE DIACETATE

Formula:  $(\text{CH}_3\text{COOCH}_2\text{CH}_2)_2$

Formula Weight: 174.2

Melting Point: 12° C.

Boiling Point: 230° C. (at 751 mm.)

Specific Gravity: 1.048 at 15° C.

## DIETHYLENE GLYCOL

## Synonyms:

2, 2'- or  $\beta, \beta'$ -dihydroxydiethyl ether  
 2, 2'-oxydiethanol  
 diglycol  
 di-2-hydroxyethyl ether  
 glycol ether

Formula:  $\text{CH}_2\text{OHCH}_2\text{OCH}_2\text{CH}_2\text{OH}$

## Characteristics:

nearly odorless              hygroscopic  
 sweetish taste

Formula Weight: 106.1

Melting Point: -10.5 to -6.5° C.

## Boiling Point:

244.5 to 250° C. (at 760 mm.)

246° C. (at 760 mm.)

230 to 240° C. (at 760 mm.)

164° C. (at 50 mm.)

## Specific Gravity:

1.132 at 0° C.

1.1177 at 20° C.

1.118(20/20)

1.116(77/77)° F.

9.3 lbs. per gal. at 20° C.

## Refractive Index:

1.4475

1.4416 at 77° F.

## Surface Tension (dynes per cm.):

48.5 at 25° C.

## Viscosity (poises):

0.50 at 15° C.

0.30 at 25° C.

0.38 at 20° C.

## Flash Point:

275 to 290° F. (open)

255° F. (closed)

Specific Heat (gram-calories per g.  
 per ° C.): 0.5509 (liquid) at 20° C.

Heat of Vaporization (gram-calories  
 per g.): 150 at the boiling point

## Uses:

solvent for dyes, gums, nitrocellulose,  
 oils, organic compounds, resins,  
 lacquers, and plastics  
 organic syntheses  
 refrigerator antifreeze  
 sprinkler antifreeze  
 lubricating and finishing agent for  
 textiles  
 resin manufacture  
 explosives manufacture

## Solubility:

∞ (of water)

∞ (in chloroform)

∞ (in water)

soluble in alcohol, ethylene glycol,  
 ether, acetone

insoluble in benzene, toluene, and  
 carbon tetrachloride

## Additional Data:

40% aqueous solution by vol. freezes  
 at -18° C., 50% solution by vol.

freezes at -28° C.

autoignition temperature, 444° F.

## DIETHYLENE GLYCOL (Cont.)

apparent ignition temperature in air,  
663° F.

electrical conductivity,

$0.586 \times 10^{-6}$  mhos

pour point, -80° F.

fire point, open cup, 293° F.

vapor density, 3.66

DIETHYLENE GLYCOL  
bis(ALLYLCARBONATE)

Synonyms: allyl diglycol carbonate

Formula:  $(\text{CH}_2\text{CHCH}_2\text{OCOOCH}_2\text{CH}_2)_2\text{O}$

Characteristics:

none to slightly allylic odor

Formula Weight: 274.3

Melting Point: -4 to 0° C.

Boiling Point: 160° C. (at 2 mm.)

Specific Gravity:

1.143(20/4)

9.4 to 9.6 lbs. per gal. at 20° C.

Refractive Index: 1.4503

Surface Tension (dynes per cm.):

35 at 20° C.

Viscosity (centipoises): 9 at 25° C.

Flash Point: 378° F. (open)

Uses:

copolymerization agent

organic syntheses

plasticizer

solvent of low volatility

Solubility:

insoluble in water

soluble in alcohol, ether, ethyl acetate,

acetic acid, acetone, vinyl acetate,

methyl methacrylate, styrene

partly soluble in amyl alcohol, carbon

disulfide, gasoline, and ligroin

insoluble in glycol

insoluble in glycerol

Additional Data:

effect on skin - variable, subject to  
personal sensitivity

Compatability

Complete	Limited	None
many alkyl resins	Arochlors	polybutene
dibutyl phthalate	cellulose acetate	polystyrene
methyl poly- methacrylate	methyl abietate	
polyvinyl acetate	nitro- cellulose	
sucroseace- toacetate		
triacetin		

DIETHYLENE GLYCOL  
bis (2-BUTOXYETHYL CARBONATE)

Synonyms:

butoxyethyl diglycol carbonate

Formula:

$[\text{CH}_3(\text{CH}_2)_3\text{O}(\text{CH}_2)_2\text{OCOOCH}_2\text{CH}_2]_2$

Characteristics: practically no odor

Formula Weight: 394.5

Boiling Point: 200 to 206° C. (at 2 mm.)

Vapor Pressure (mm. Hg):

< 0.001 at 20° C.

Specific Gravity:

1.078 at 20° C.

8.95 lbs. per gal. at 20° C.

change in density,

0.00089 at 20 to 50° C.

Refractive Index: 1.4426

Surface Tension (dynes per cm.):

28.3 at 20° C.

Viscosity (centipoises):

45.3 at 20° C.

3.4 at 100° C.

11.8 at 50° C.

Flash Point: 379° F. (closed)

## Heat of Vaporization:

49 gram-calories per g. at

190 to 250° C.

29 Btu. per lb. at 375 to 480° F.

## Uses:

lubricant  
 pharmaceutical compositions  
 plasticizer  
 softening agent  
 high boiling solvent

## Solubility (grams per 100 ml.):

1.0 (of water) 0.4 (in water)

partially soluble in monoethylene glycol

partially soluble in diethylene glycol  
 insoluble in mineral oilmiscible with acetic acid, acetone,  
 amyl alcohol, benzene, carbon  
 disulfide, methyl alcohol, ethyl  
 acetate, ether, and ethyl alcohol

## Additional Data:

fire point, 410° F.

thermal decomposition temperature,  
 295° C.volatility at 100° C., 0.12 mg. per sq.  
 cm. per hr.

stability to hydrolysis, &lt;0.5%

hydrolyzed after 6 hours contact with  
 boiling watersee: Table of Compatibility with  
 Resins and Polymers, Diethylene  
 Glycol bis (Phenyl Carbonate)  
 page 289
 DIETHYLENE GLYCOL  
 bis (BUTYL CARBONATE)

Synonyms: butyl diglycol carbonate

## Formula:



Characteristics: practically no odor

Formula Weight: 306.4

Boiling Point: 164 to 166° C. (at 2 mm.)

Vapor Pressure (mm. Hg):

0.001 at 20° C.

## Specific Gravity:

1.068 at 20° C.

8.90 lbs. per gal. at 20° C.

change in density, 0.00091 grams  
 per cm. per ° C.

Refractive Index: 1.4350

Surface Tension (dynes per cm.)

29.4 at 20° C.

Viscosity (centipoises):

20.9 at 20° C. 2.3 at 100° C.

6.8 at 50° C.

Flash Point: 372° F. (closed)

## Heat of Vaporization:

57 gram-calories per g. at

150 to 250° C.

100 Btu. per lb. at 300 to 480° F.

## Uses:

lubricant  
 pharmaceutical compositions  
 plasticizer  
 softening agent  
 high boiling solvent

## Solubility (grams per 100 ml.):

1.2 (of water) 0.001 (in water)

partially soluble in monoethylene glycol

partially soluble in diethylene glycol

insoluble in mineral oil

insoluble in petroleum ether

miscible with acetic acid, acetone,  
 amyl alcohol, benzene, carbon  
 disulfide, methyl alcohol, ethyl  
 acetate, ether, and ethyl alcohol

## Additional Data:

fire point, 401° F.

thermal decomposition temperature,  
 270° C.volatility at 100° C., 0.59 mg. per  
 sq. cm. per hr.

stability to hydrolysis, &lt;0.5%

hydrolyzed after 6 hours' contact  
 with hot watersee: Table of Compatibility with  
 Resins and Polymers, Diethylene  
 Glycol bis (Phenyl Carbonate)  
 page 289

DIETHYLENE GLYCOL  
bis (CHLOROFORMATE)

Synonyms: diglycol chloroformate

Formula:  $(\text{ClCOOCH}_2\text{CH}_2)_2\text{O}$

Characteristics:  
mild, distinctive odor

Formula Weight: 231.0

Melting Point: 5.3 to 5.7° C.

Boiling Point: 125 to 127° C. (at 5 mm.)

Specific Gravity:  
1.389(20/4)  
11.6 lbs. per gal. at 20° C.

Refractive Index: 1.4542

Vapor Pressure (mm. Hg):  
<0.1 at 50° C.      17.5 at 150° C.  
0.1 at 75° C.      62 at 175° C.  
0.8 at 100° C.      194 at 200° C. with  
4.2 at 125° C.      decomposition

Surface Tension (dynes per cm.):  
37.8 at 20° C.

Viscosity (centipoises):  
9.6 at 20° C.      1.4 at 100° C.  
3.5 at 50° C.

Flash Point: >200° F. (closed)

Heat of Vaporization (gram-calories  
per g.): 82.6 at 115 to 185° C.

Uses: organic syntheses

Solubility (grams per 100 ml.):  
0.2 (of water)      0.3 (in water)  
miscible with acetone, alcohol,  
diethylene glycol, ether, methyl  
alcohol, ethyl acetate, and benzene  
immiscible with monoethylene glycol,  
and petroleum ether

DIETHYLENE GLYCOL  
bis (PHENYLCARBONATE)

Synonyms: phenyl diglycol carbonate

Formula:  $(\text{C}_6\text{H}_5\text{OOCOCH}_2\text{CH}_2)_2\text{O}$

Characteristics: practically no odor

Formula Weight: 346.3

Melting Point: 39 to 40° C.

Boiling Point: 225 to 229° C. (at 2 mm.)

Vapor Pressure (mm. Hg):  
<0.001 at 20° C.

Specific Gravity:  
1.232 at 20° C. (supercooled)  
10.3 lbs. per gal.  
change in density, 0.00090 grams  
per cm. per ° C. at 20 to 50° C.

Refractive Index: 1.5254

Surface Tension (dynes per cm.):  
23.0 at 20° C.

Viscosity (centipoises):  
1810 at 20° C. (supercooled)  
72.4 at 50° C.      8.2 at 100° C.

Flash Point: 460° F. (closed)

Heat of Vaporization:  
63 gram-calories per g. at  
210 to 250° C.  
115 Btu. per lb. at 410 to 480° F.

Uses:  
lubricant  
pharmaceutical compositions  
plasticizer  
softening agent  
high boiling solvent

Solubility (grams per 100 ml.):  
0.6 at 25° C. (of water)  
<0.01 (in water)  
partially soluble in alcohol  
partially soluble in diethylene glycol  
insoluble in amyl alcohol, mineral oil,  
petroleum ether, and monoethylene  
glycol  
miscible with acetic acid, acetone,  
benzene, carbon disulfide, methyl  
alcohol, ethyl acetate, and ether

Additional Data:  
fire point, 518° F.  
thermal decomposition temperature,  
270° C.  
volatility at 100° C.,  
0.026 mg per sq. cm. per hr.  
stability to hydrolysis, <0.5%  
hydrolyzed after 6 hours' contact with  
hot water

Compatibility with Resins and Polymers

Resins and Polymers	Ratio of Ether-ester to Resin or Polymer								
	Diethylene Glycol bis (2-Butoxy- ethyl Carbonate)			Diethylene Glycol bis (Butyl Car- bonate)			Diethylene Glycol bis (Phenyl Car- bonate)		
	1:1	1:3	1:9	1:1	1:3	1:9	1:1	1:3	1:9
Benzyl Cellulose	C	C	C	C	C	C	C	C	C
Cellulose Acetate	I	I	I	I	I	C	I	C	C
Cellulose Acetate-Butyrate	C	C	C	I	C	C	C	C	C
Chlorinated Rubber	C	C	C	C	C	C	C	C	C
Cumarone-Indene Resin	C	C	C	C	C	C	C	C	C
Damar	I	C	C	I	C	C	I	I	C
Ethyl Cellulose	C	C	C	C	C	C	C	C	C
Glyceryl Phthalate Alkyd	C	C	C	C	C	C	C	C	C
Hycar OR	C	C	C	C	C	C	C	C	C
Neoprene	I	C	C	I	C	C	I	C	C
Nitrocellulose	C	C	C	C	C	C	C	C	C
Polyisobutylene	I	I	I	I	I	I	I	C	C
Polymethyl Methacrylate	C	C	C	C	C	C	C	C	C
Polystyrene	I	I	C	I	I	C	I	I	C
Polyvinyl Acetal	C	C	C	C	C	C	C	C	C
Polyvinyl Acetate	C	C	C	C	C	C	C	C	C
Polyvinyl Chloride	I	C	C	I	C	C	I	C	C
Polyvinyl Chloride-Acetate	C	C	C	C	C	C	I	C	C
Rosin	C	C	C	C	C	C	C	C	C

C = Compatible  
I = Incompatible

## DIETHYLENE GLYCOL DIACETATE

Formula:  $(\text{CH}_3\text{COOC}_2\text{H}_4)_2\text{O}$ 

Formula Weight: 190.2

Boiling Point:

250° C. (at 760 mm.)

238 to 251° C. (at 760 mm.)

Specific Gravity:

1.116(20/20)

9.3 lbs. per gal. at 20° C.

Flash Point: 275° F. (open)

Solubility:

 $\infty$  (of water) $\infty$  (in water)

Additional Data:

coefficient of expansion,

0.00095 at 10 to 30° C.

dilution ratio with xylene, 1.3

immiscible with mineral spirits

## DIETHYLENE GLYCOL DINITRATE

Formula:  $(\text{O}_2\text{NOC}_2\text{H}_4)_2\text{O}$ 

Formula Weight: 196.1

Melting Point: -11.3° C.

Specific Gravity: 1.377(25/4)

Solubility: insoluble in water

## DIETHYLENE GLYCOL DIOLEATE

Formula:  $(\text{C}_{17}\text{H}_{33}\text{COOC}_2\text{H}_4)_2\text{O}$ 

Characteristics: pale yellow

Formula Weight: 635.0

Specific Gravity: 0.9310(20/4)

Solubility:

disperses in water

 $\infty$  (in alcohol) $\infty$  (in ether)

## DIETHYLENE GLYCOL DIPROPIONATE

Synonyms: KP-45

Formula:  $(\text{C}_2\text{H}_5\text{COOC}_2\text{H}_4)_2\text{O}$ 

Characteristics:

slight characteristic odor

Formula Weight: 218

Melting Point: &lt; -18° C.

Boiling Point:

255 to 276° C. (at 760 mm.) (90%)

110 to 145° C. (at 4 mm.)

Specific Gravity: 1.066 at 20° C.

Flash Point: 260° F. (closed)

Uses:

solvent for Hercose AP, cellulose

acetate and many other resins

it increases the flexibility of Vinylite films

Solubility:

2% by volume at 20° C. (of water)

4% by volume at 20° C. (in water)

resin solubility: nitrocellulose,

cellulose acetate, ethyl cellulose,

Parlon, Vinsol, Vinylite resins,

copal ester, and many other resins

Damar is partly soluble

miscible with alcohols, ketones,

gasolines, mineral oil, benzene,

toluene, xylene, glacial acetic acid,

butyl acetate, carbon tetrachloride,

chlorobenzene, dichloroethane,

Cellosolve, Carbitol, diethylene

glycol, various plasticizers, and

most other organic solvents

90% volatile after 100 hours at 100° C.

fire point, 295° F.

hydrolysis, 1.25% (refluxed two hours with water)

## DIETHYLENE GLYCOL MONOLAURATE

Synonyms: Glaurin, diglycol laurate

Formula:  $\text{C}_{11}\text{H}_{23}\text{COOC}_2\text{H}_4\text{OC}_2\text{H}_4\text{OH}$ 

Characteristics:

straw colored

oily

Formula Weight: 288.4

Melting Point: 17 to 18° C.

Boiling Point: &gt;270° C. (at 760 mm.)

Specific Gravity: 0.960

## Uses:

solvent for carbon paper and type-  
writer ribbon dyes  
emulsifying agent      lubricants  
plasticizer              polishes  
softener                  varnish removers  
cosmetics

## Solubility:

insoluble in water  
soluble in alcohol, ether, methyl  
alcohol, acetone, ethyl acetate,  
toluene, mineral oil, vegetable oil,  
diethylene glycol  
partially soluble in mineral spirits

## Additional Data:

acid value, 4 to 8 (3% lauric)  
iodine value, 5 to 8 (9 to 11)  
saponification value, 191  
titer, 9 to 11  
pH of 5% aqueous dispersion,  
9.0 to 9.2 at 25°C.

## DIETHYLENETRIAMINE

Synonyms: 2, 2'-diaminodiethylamine

Formula:  $(\text{NH}_2\text{C}_2\text{H}_4)_2\text{NH}$

## Characteristics:

colorless to yellow      viscous  
hygroscopic              strongly alkaline

Formula Weight: 103.2

## Boiling Point:

207.1 to 208°C. (at 760 mm.)  
slight decomposition  
185 to 215°C. (at 760 mm.)

## Specific Gravity:

0.9856(20/20)              0.9542(20/20)  
8.0 lbs. per gal. at 20°C.

Flash Point: 215°F. (open)

## Uses:

solvent for acid gases, dyes, some  
resins, and sulfur  
organic syntheses      saponifying agent  
gas purification and dehydration

## Solubility:

$\infty$  (of water)               $\infty$  (in water)  
very soluble in alcohol  
insoluble in ether

## Additional Data:

vapor density, 3.48  
pH of 25% solution, 12.5 at 25°C.

## DIETHYL ETHYLBUTYLMALONATE

## Synonyms:

ethyl ethylbutylmalonate  
ethylbutylmalonic acid diethyl ester

Formula:  $\text{C}_4\text{H}_9\text{C}(\text{C}_2\text{H}_5):(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 244.3

Boiling Point: 235 to 245°C. (at 760 mm.)

## DIETHYL ETHYLISOAMYLMALONATE

## Synonyms:

ethyl ethylisoamylmalonate  
ethylisoamylmalonic acid diethyl ester

Formula:  $\text{C}_5\text{H}_{11}\text{C}(\text{C}_2\text{H}_5):(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 258.4

Boiling Point: 131 to 133°C. (at 15 mm.)

## DIETHYL ETHYLISOPROPYLMALONATE

## Synonyms:

ethyl ethylisopropylmalonate  
ethylisopropylmalonic acid diethyl  
ester

Formula:  $\text{C}_3\text{H}_7\text{C}(\text{C}_2\text{H}_5):(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 220.3

Boiling Point: 232 to 233°C. (at 760 mm.)

## DIETHYL ETHYLMALONATE

## Synonyms:

ethyl ethylmalonate  
ethylmalonic acid diethyl ester  
ethylmalonic ester

Formula:  $\text{C}_2\text{H}_5\text{CH}(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 188.2

## Boiling Point:

211°C. (at 748 mm.)  
95 to 97°C. (at 15 mm.)

Specific Gravity: 1.004(20/20)

## DIETHYL ETHYLPHENYLMALONATE

## Synonyms:

ethyl ethylphenylmalonate  
ethylphenylmalonic acid diethyl ester

Formula:  $C_6H_5C(C_2H_5):(COOC_2H_5)_2$

Formula Weight: 264.3

Boiling Point: 166° C. (at 12 mm.)

## DIETHYL ETHYLMETHYLMALONATE

## Synonyms:

diethyl methylethylmalonate  
ethyl methylethylmalonate  
methylethylmalonic acid diethyl ester

Formula:  $C_2H_5C(CH_3)(COOC_2H_5)_2$

Formula Weight: 202.2

Boiling Point: 207 to 208° C. (at 760 mm.)

Specific Gravity: 0.994(15/15)

## DIETHYLFORMAL

## Synonyms:

diethoxymethane ethylal  
formaldehyde diethylacetal  
methylene diethyl ester

Formula:  $CH_2(OC_2H_5)_2$

Formula Weight: 104.2

Melting Point: -66.5° C.

Boiling Point: 89° C. (at 760 mm.)

## Specific Gravity:

0.824(25/4) 0.8347 at 15° C.

Solubility (grams per 100 ml.):

9 at 18° C.

7 at 30° C. (in water)

∞ (in alcohol) ∞ (in ether)

## DIETHYLFORMAMIDE

## Synonyms:

N, N-diethylformamide  
formyldiethylamine  
N-formyldiethylamine

Formula:  $HCOON(C_2H_5)_2$

Formula Weight: 101.2

Boiling Point: 177 to 178° C. (at 760 mm.)

## Solubility:

∞ (in water)  
very soluble in alcohol  
very soluble in ether

## DIETHYL HEPTYLMALONATE

## Synonyms:

ethyl heptanepropanedioate  
ethyl 1,1-octanedicarboxylate  
heptylmalonic acid diethyl ester

Formula:  $CH_3(CH_2)_6CH(COOC_2H_5)_2$

Characteristics: pale yellow

Formula Weight: 258.4

Boiling Point: 144 to 146° C. (at 8 mm.)

## DIETHYL ISOBUTYLMALONATE

## Synonyms:

ethyl isobutylmalonate  
isobutylmalonic acid diethyl ester

Formula:  $(CH_3)_2CHCH_2CH(COOC_2H_5)_2$

Formula Weight: 216.3

## Boiling Point:

225° C. (at 760 mm.)

113 to 116° C. (at 1 mm.)

Specific Gravity: 0.983 at 17° C.

## Solubility:

very slightly soluble in water  
very soluble in alcohol  
very soluble in ether

## DIETHYL ISOPHTHALATE

## Synonyms:

ethyl m-phthalate  
ethyl isophthalate  
isophthalic acid diethyl ester

Formula:  $C_6H_4(COOC_2H_5)_2$

Formula Weight: 222.2

Melting Point: 11.5° C.

## Boiling Point:

285° C. (at 760 mm.)

302° C. (at 760 mm.)

Specific Gravity: 1.123(25/25)

Solubility:

insoluble in  $\infty$  (in alcohol)  
water  $\infty$  (in ether)

DIETHYL ISOPROPYLMALONATE

Synonyms:

ethyl isopropylmalonate  
isopropylmalonic acid diethyl ester

Formula:  $(\text{CH}_3)_2\text{CHCH}(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 202.3

Boiling Point: 211 to 215° C. (at 760 mm.)

Specific Gravity:

0.993(15/15) 0.984(25/4)

Refractive Index: 1.418

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

N,N-DIETHYL LAURAMIDE

Formula:  $\text{C}_{11}\text{H}_{23}\text{CON}(\text{C}_2\text{H}_5)_2$

Characteristics: faint odor

Formula Weight: 255.4

Freezing Point: 4.0° C.

Boiling Point: 166 to 177° C. (at 2 mm.)

Specific Gravity: 0.868(20/20)

Refractive Index: 1.455

Viscosity (centipoises): 9.4 at 25° C.

Flash Point: >150° F. (closed)

Solubility:

insoluble in water  
soluble in methyl alcohol, ether,  
gasoline, acetone, benzene, and ethyl  
acetate

Additional Data:

coefficient of expansion,  
0.00089 per ° C.

DIETHYLMERCURY

Synonyms: mercury diethyl

Formula:  $(\text{C}_2\text{H}_5)_2\text{Hg}$

Formula Weight: 258.7

Boiling Point: 159° C. (at 760 mm.)

Specific Gravity: 2.243(23/4)

Solubility:

insoluble in water  
slightly soluble in alcohol  
very soluble in ether

DIETHYL MESOXALATE

Synonyms:

diethyl oxopropanedioate  
ethyl ketomalonate  
ethyl mesoxalate  
ethyl oxomalonate  
mesoxalic acid diethyl ester

Formula:  $\text{CO}(\text{COOC}_2\text{H}_5)_2$

Characteristics: yellow green oil

Formula Weight: 174.2

Melting Point: -30° C.  $\pm$

Boiling Point:

220° C.  $\pm$  (at 760 mm.)  
115° C. (at 29 mm.)

Specific Gravity: 1.119(20/20)

Refractive Index: 1.4187 at 15.6° C.

Solubility:

soluble in alcohol soluble in ether

DIETHYLMETHYLAMINE

Synonyms: methyldiethylamine

Formula:  $\text{CH}_3\text{N}(\text{C}_2\text{H}_5)_2$

Formula Weight: 87.2

Boiling Point: 65 to 67° C. (at 760 mm.)

Solubility:

very soluble in water  
soluble in alcohol soluble in ether

N-DIETHYL-a-NAPHTHYLAMINE

Synonyms: N,N-diethyl-1-naphthylamine

Formula:  $C_{10}H_7N(C_2H_5)_2$ 

Characteristics: oily

Formula Weight: 199.3

Boiling Point: 285 to 290°C. (at 760 mm.)

Specific Gravity: 1.005

Refractive Index: 1.5933 at 18.1°C.

Solubility:

∞ (of water)	∞ (in alcohol)
∞ (in water)	∞ (in benzene)

N,N-DIETHYL-o-NITROANILINE

Synonyms: o-nitrodiethylaniline

Formula:  $NO_2C_6H_4N(C_2H_5)_2$ 

Characteristics: yellow

Formula Weight: 194.2

Boiling Point: 153 to 155°C. (at 20 mm.)

Solubility:

slightly soluble in water	
soluble in alcohol	soluble in ether

N,N-DIETHYL-m-NITROANILINE

Synonyms: m-nitrodiethylaniline

Formula:  $NO_2C_6H_4N(C_2H_5)_2$ 

Characteristics: yellow

Formula Weight: 194.2

Boiling Point: 288 to 290°C. (at 760 mm.)

## DIETHYL OXALACETATE

Synonyms:

diethyl hydroxybutenedioate
diethyl oxobutanedioate
oxalacetic acid diethyl ester
oxalacetic ester

Formula:  $(CH_2CO)(COOC_2H_5)_2$ 

Characteristics: oily

Formula Weight: 188.2

Boiling Point: 131 to 132°C. (at 24 mm.)

Specific Gravity: 1.131(20/4)

Refractive Index: 1.4561 at 15.6°C.

Solubility:

insoluble in water	∞ (in ether)
∞ (in alcohol)	∞ (in benzene)

## DIETHYL PEROXIDE

Formula:  $C_2H_5OOC_2H_5$ 

Formula Weight: 90.1

Boiling Point: 65°C. (at 760 mm.)

Specific Gravity: 0.827(15/4)

Inflammability Range (volume per cent in air): 2.35

Solubility:

very slightly soluble in water
∞ (in alcohol)      ∞ (in ether)

## DIETHYLPHENYLMETHANE

Synonyms: sec-amylbenzene

Formula:  $(C_2H_5)_2CHC_6H_5$ 

Formula Weight: 148.2

Boiling Point: 187°C. (at 753 mm.)

Specific Gravity: 0.876(15/4)

Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## DIETHYLPHOSPHORIC ACID

Synonyms: diethyl hydrogen phosphate

Formula:  $(C_2H_5O)_2POOH$ 

Formula Weight: 154.1

Boiling Point: 203.3°C. (at 760 mm.)

Specific Gravity: 1.175 at 0°C.

## DIETHYL PHTHALATE

## Synonyms:

diethyl *o*-phthalate  
ethyl phthalate  
phthalic acid diethyl ester

Formula:  $C_6H_4(COOC_2H_5)_2$

## Characteristics:

oily  
very slight aromatic odor

Formula Weight: 222.2

Melting Point:  $-40.5^\circ C$ .

## Boiling Point:

$296.1^\circ C$ . (at 760 mm.)  
 $294.0^\circ C$ . (at 760 mm.)  
 $200$  to  $207^\circ C$ . (at 50 mm.)

## Specific Gravity:

1.123(25/4)  
1.119 to 1.121(20/20)  
9.13 lbs. per gal. at  $20^\circ C$ .

## Refractive Index:

1.5019                      1.5013

Surface Tension (dynes per cm.): 37.5

## Viscosity (millipoises):

absolute viscosity, 101 at  $25^\circ C$ .

## Flash Point:

$335^\circ F$ . (open)               $243^\circ F$ . (closed)

## Uses:

camphor	perfume fixative
substitutes	wetting agent
dopes	plastics
insecticides	plasticizer
lacquers	
solvent for cellulose acetate and nitrocellulose	

## Solubility (per cent by volume):

1.5 (of water) at  $25^\circ C$ .  
0.090 (in water) at  $25^\circ C$ .  
 $\infty$  (in alcohol)               $\infty$  (in ether)  
soluble in benzene  
miscible with alcohols, aromatic hydrocarbons, esters and ketones  
partly miscible with aliphatic solvents

## Additional Data:

coefficient of expansion,  
0.00042 per  $^\circ F$ .    0.00076 per  $^\circ C$ .  
evaporation rate, 0.000617 g./sq. cm./hr. at  $100^\circ C$ .  
light fastness in nitrocellulose and in cellulose acetate mixtures, excellent  
fire retardation, none  
dilution ratio (nitrocellulose solution method),  
with toluene . . . . . 3.8  
with petroleum naphtha. . . . 0.7  
vapor density, 7.66

N,N-DIETHYL-1,3-PROPANEDIAMINE

## Synonyms:

3-diethylaminopropylamine  
1,3-bis-ethylaminobutane

Formula:  $(C_2H_5)_2NCH_2CH_2CH_2NH_2$

Characteristics: amine odor

Formula Weight: 130.2

Boiling Point:  $165$  to  $170^\circ C$ . (at 760 mm.)

Specific Gravity: 0.825(20/20)

Refractive Index: 1.443

## Solubility:

soluble in water, methyl alcohol, ether, acetone, benzene, gasoline, and ethyl acetate

DIETHYL PROPYLMALONATE

## Synonyms:

ethyl 1,1-butanedicarboxylate  
ethyl propylpropanedioate  
propylmalonic acid diethyl ester

Formula:  $CH_3CH_2CH_2CH(COOC_2H_5)_2$

Formula Weight: 202.3

## Boiling Point:

$221^\circ C$ . (at 760 mm.)  
 $225$  to  $226^\circ C$ . (at 771 mm.)

Specific Gravity: 0.993(15/15)

## Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## 2,3-DIETHYL QUINOLATE

Formula:  $C_5H_3N(COOC_2H_5)_2$ 

Characteristics:

yellow                      oily

Formula Weight: 232.2

Boiling Point:

280 to 285° C. (at 760 mm.)

slight decomposition

Solubility:

soluble in water, alcohol, ether, and  
benzene

## DIETHYLSTEARAMIDE

Formula:  $C_{17}H_{35}CON(C_2H_5)_2$ 

Characteristics:

pale yellow                      slight amide odor

Formula Weight: 339.6

Freezing Point: 16 to 18° C.

Boiling Point: 119 to 205° C. (at 1 mm.)

Specific Gravity: 0.866(20/20)

Flash Point: 375° F. (closed)

Solubility:

insoluble in water  
soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and ethyl  
acetate

## DIETHYLTIN

Synonyms: tin diethyl

Formula:  $(C_2H_5)_2Sn$ 

Characteristics:

yellow                      oily

Formula Weight: 176.8

Boiling Point: decomposes

Specific Gravity: 1.558 at 15° C.

Solubility:

insoluble in water  
soluble in alcohol, and in ether

## 3,5-DIETHYLTOLUENE

Synonyms: 1,3-diethyl-5-methylbenzene

Formula:  $(C_2H_5)_2C_6H_3CH_3$ 

Formula Weight: 148.2

Boiling Point: 198 to 200° C. (at 760 mm.)

Specific Gravity: 0.879(20/4)

Solubility:

insoluble in                      ∞ (in alcohol)  
water                              ∞ (in ether)N,N-DIETHYL o-TOLUIDINE

Synonyms:

o-ethyltoluidineo-methyl n-diethylaminobenzeneFormula:  $CH_3C_6H_4N(C_2H_5)_2$ 

Formula Weight: 163.3

Boiling Point: 208 to 209° C. (at 755 mm.)

Solubility:

insoluble in water  
soluble in alcohol and in etherN,N-DIETHYL m-TOLUIDINE

Synonyms:

m-ethyltoluidinem-methyl diethylaminobenzeneFormula:  $CH_3C_6H_4N(C_2H_5)_2$ 

Formula Weight: 163.3

Boiling Point: 231 to 232° C. (at 760 mm.)

Solubility:

insoluble in water  
soluble in alcohol and in etherN,N-DIETHYL p-TOLUIDINE

Synonyms:

p-ethyltoluidinep-methyl diethylaminobenzeneFormula:  $CH_3C_6H_4N(C_2H_5)_2$ 

Formula Weight: 163.3

Boiling Point: 228 to 229° C. (at 760 mm.)

Specific Gravity: 0.924 at 15.5° C.

**3,9-DIETHYL-6-TRIDECANAL**

Synonyms: heptadecanal

Formula:



Characteristics: mild odor

Formula Weight: 256.5

Boiling Point: 309° C. (at 760 mm.)

Vapor Pressure (mm. Hg):

<0.01 at 20° C.

Specific Gravity: 0.8475(20/20)

Flash Point: 310° F. (open)

Uses:

antifoaming agent

synthetic intermediate in manufacture  
of cosmetics, detergents, dyes,  
insecticides, and pharmaceuticals

Solubility:

0.46% (of water)      0.02% (in water)

**N, N-DIETHYLVALERAMIDE**

Synonyms:

isovaleryl diethylamide

valyl

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CON}(\text{C}_2\text{H}_5)_2$

Formula Weight: 157.3

Boiling Point: 210° C. (at 760 mm.)

Solubility:

decomposes in water

soluble in alcohol and in ether

**DIETHYLZINC**

Synonyms:

zinc diethyl

zinc ethide

Formula:  $(\text{C}_2\text{H}_5)_2\text{Zn}$

Formula Weight: 123.5

Melting Point: -28° C.

Boiling Point: 118° C. (at 760 mm.)

Specific Gravity: 1.182 at 18° C.

Solubility:

decomposes in water and in alcohol

**DIFLUOROACETIC ACID**

Synonyms: difluoroethanoic acid

Formula:  $\text{CHF}_2\text{COOH}$

Formula Weight: 96.0

Melting Point: -0.35° C.

Boiling Point: 134.2° C. (at 766 mm.)

Specific Gravity: 1.536 at 10° C.

Solubility:

∞ (in water)

∞ (in alcohol)

∞ (in ether)

**1,1-DIFLUORO-2-iodoethane**

Formula:  $\text{CHF}_2\text{CH}_2\text{I}$

Formula Weight: 192.0

Boiling Point: 89.5° C. (at 760 mm.)

Specific Gravity: 2.243 at 12.2° C.

Solubility: insoluble in water

**DIFURFURYLAMINE**

Synonyms:

d, d-di-2-furyldimethylamine

di-2-furfurylamine

Formula:  $(\text{C}_4\text{H}_3\text{OCH}_2)_2\text{NH}$

Formula Weight: 177.2

Boiling Point:

102 to 103° C. (at 1 mm.)

103 to 106° C. (at 2 to 3 mm.)

Solubility:

insoluble in water

soluble in ether

**DIGLYCEROL**

Formula:  $[\text{C}_3\text{H}_5(\text{OH})_2]_2\text{O}$

Formula Weight: 166.2

Boiling Point: 220 to 230° C. (at 10 mm.)

Solubility:

soluble in hot water

∞ (in ether)

## DIHEXYLAMINE

Formula:  $[\text{CH}_3(\text{CH}_2)_5]_2\text{NH}$ 

Formula Weight: 185.3

Boiling Point:  $233$  to  $243^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.788(20/20)$ Refractive Index:  $1.434$ Flash Point:  $220^\circ\text{F}$ . (open)

Solubility:

insoluble in water

soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and ethyl  
acetateℓ-DIHYDROCARVONESynonyms: p-menth-8(9)-en-2-oneFormula:  $\text{C}_{10}\text{H}_{16}\text{O}$ 

Characteristics: oily

Formula Weight: 152.2

Boiling Point:  $220$  to  $223^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.9253(20/4)$ Refractive Index:  $1.4717$  at  $19^\circ\text{C}$ .

## DIHYDROPYRAN

Synonyms: Elchem 880

Formula:  $\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}=\text{CHO}$ 

Characteristics:

mobile liquid

ether-like penetrating odor

Formula Weight: 84.1

Boiling Point:  $86^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.923(20/4)$ Refractive Index:  $1.4400$ Flash Point:  $4^\circ\text{F}$ . (closed)

Solubility (grams per 100 ml.):

3 (in water)

soluble in most organic solvents

Additional Data:

keep away from heat and open flame

use with adequate ventilation

avoid prolonged or repeated breathing  
of vapor or contact with the skin

## DIHYDROQUINOLINE

Formula:  $\text{C}_9\text{H}_9\text{N}$ 

Formula Weight: 131.2

Boiling Point:  $220$  to  $226^\circ\text{C}$ . (at 760 mm.)

## 1,2-DIHYDROTOLUENE

Synonyms: methylcyclohexadiene

Formula:  $\text{CH}_3\text{C}_6\text{H}_7$ 

Formula Weight: 94.2

Boiling Point:

 $108$  to  $110.1^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.8354(20/4)$ Refractive Index:  $1.4763$ 

## 1,3-DIHYDROTOLUENE

Synonyms: methylcyclohexadiene

Formula:  $\text{CH}_3\text{C}_6\text{H}_7$ 

Formula Weight: 94.2

Boiling Point:  $110^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.835

## 2,4-DIHYDROTOLUENE

Synonyms: methylcyclohexadiene

Formula:  $\text{CH}_3\text{C}_6\text{H}_7$ 

Formula Weight: 94.2

Boiling Point:  $106^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.827(20/4)$ x,x-DIHYDRO-o-XYLENE

Synonyms:

cantharene

dihydro-o-xylene

dimethyl cyclohexadiene

Formula:  $C_6H_6(CH_3)_2$

Characteristics: oily

Formula Weight: 108.2

Boiling Point: 134 to 135° C. (at 760 mm.)

Specific Gravity: 0.8521(20/4)

Refractive Index: 1.4895

Solubility: soluble in ether

### 1, 5-DIHYDRO-m-XYLENE

Synonyms:

dihydro-m-xylene

dimethyl cyclohexadiene

Formula:  $C_6H_6(CH_3)_2$

Formula Weight: 108.2

Boiling Point: 129 to 130° C. (at 745 mm.)

Specific Gravity: 0.823(20/4)

### 1, 3-DIHYDRO-p-XYLENE

Synonyms:

dihydro-p-xylene

dimethylcyclohexadiene

Formula:  $C_6H_6(CH_3)_2$

Formula Weight: 108.2

Boiling Point: 135 to 138° C. (at 760 mm.)

Specific Gravity: 0.830(20/4)

### 1, 4-DIODOBUTANE

Synonyms: tetramethylene diiodide

Formula:  $CH_2I(CH_2)_2CH_2I$

Formula Weight: 309.9

Melting Point: 5.8° C.

Boiling Point: 120 to 125° C. (at 12 mm.)

Specific Gravity: 2.307 at 18° C.

### 1, 1-DIODOETHANE

Synonyms:

uns-diiodoethane ethylidene iodide

ethylidene diiodide

Formula:  $CH_3CHI_2$

Formula Weight: 281.9

Boiling Point: 177 to 179° C. (at 760 mm.)

Specific Gravity: 2.84(0/4)

Solubility:

insoluble in water

very soluble in alcohol and in ether

### 1, 6-DIODOHEXANE

Synonyms:

hexamethylene diiodide

1, 6-hexylene iodide

Formula:  $CH_2I(CH_2)_4CH_2I$

Formula Weight: 338.0

Melting Point: 6 to 9.5° C.

Boiling Point:

163° C. (at 17.5 mm.)

with decomposition

Specific Gravity: 2.05(18/4)

Refractive Index: 1.5899 at 15° C.

Solubility:

insoluble in water

very soluble in alcohol and in ether

### DIODOMETHANE

Synonyms: methylene iodide

Formula:  $CH_2I_2$

Formula Weight: 267.9

Melting Point:

4° C.

5.2 to 5.7° C.

Boiling Point:

180° C. (at 760 mm.)

with decomposition

Specific Gravity: 3.325(20/4)

Uses:

organic syntheses

separating mixtures of minerals

Solubility (grams per 100 ml.):

1.6 at 0° C. (in water)

1.4 at 20° C. (in water)

∞ (in alcohol)

∞ (in ether)

## 1,5-DIIODOPENTANE

## Synonyms:

pentamethylene diiodide  
1,5-pentylene iodide

Formula:  $\text{CH}_2\text{I}(\text{CH}_2)_3\text{CH}_2\text{I}$

Characteristics: oily

Formula Weight: 324.0

Melting Point:  $90^\circ\text{C}$ .

Boiling Point:  $149^\circ\text{C}$ . (at 20 mm.)

Specific Gravity: 2.194 at  $18^\circ\text{C}$ .

## 1,2-DIIODOPROPANE

## Synonyms:

propylene diiodide propylene iodide

Formula:  $\text{CH}_3\text{CHICH}_2\text{I}$

Formula Weight: 295.9

Boiling Point: decomposes

Specific Gravity: 2.490 at  $18.5^\circ\text{C}$ .

## 2,2-DIIODOPROPANE

## Synonyms: iodoacetol

Formula:  $(\text{CH}_3)_2\text{CI}_2$

Formula Weight: 295.9

## Boiling Point:

$147$  to  $148^\circ\text{C}$ . (at 760 mm.)  
with decomposition

Specific Gravity: 2.15 at  $0^\circ\text{C}$ .

## 1,3-DIIODOPROPANE

## Synonyms: trimethylene diiodide

Formula:  $\text{I}(\text{CH}_2)_3\text{I}$

Formula Weight: 295.9

Melting Point:  $22.5^\circ\text{C}$ .

Boiling Point:  $207.1^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 2.5631(19/4)

## Solubility:

very slightly soluble in water  
soluble in alcohol and in ether

## 1,3-DIIDO-2-PROPANOL

## Synonyms:

$\alpha$ -glycerol diiodohydrin  
iotone

Formula:  $\text{CH}_2\text{ICHOHCH}_2\text{I}$

Formula Weight: 311.9

Freezing Point:  $-20$  to  $-16^\circ\text{C}$ .

Boiling Point: decomposes

Specific Gravity: 2.4 at  $15^\circ\text{C}$ .

Solubility (grams per 100 ml.):

1.3 (in water)	$\infty$ (in chloroform)
$\infty$ (in alcohol)	$\infty$ (in benzene)
$\infty$ (in ether)	

decomposes in alkalies

## DIISOAMYLAMINE

Synonyms: bis-( $\gamma$ -methylbutyl) amine

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2]_2\text{NH}$

Formula Weight: 157.3

Melting Point:  $-44^\circ\text{C}$ .

Boiling Point:  $185$  to  $190^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.7672(21/4)

Refractive Index: 1.4229 at  $21^\circ\text{C}$ .

## Solubility:

slightly soluble in water  
soluble in alcohol and in chloroform  
 $\infty$  (in ether)

## DIISOAMYL DISULFIDE

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2]_2\text{S}_2$

Formula Weight: 206.4

## Boiling Point:

$250^\circ\text{C}$ . (at 760 mm.),  
slight decomposition

Specific Gravity: 0.918 at  $18^\circ\text{C}$ .

## DIISOBUTYLAMINE

## Synonyms:

bis ( $\beta$ -methylpropyl) amine

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2]_2\text{NH}$

Characteristics: amine odor

Formula Weight: 129.2

Melting Point:  $-70^{\circ}\text{C}$ .

Freezing Point:  $-77^{\circ}\text{C}$ .

Boiling Point:

139 to  $140^{\circ}\text{C}$ . (at 760 mm.)

136 to  $140^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.7450(20/4)                      0.746(20/20)

0.741(25/4)

Refractive Index:

1.410                                      1.4093

Viscosity (centipoises): 0.69

Flash Point:  $85^{\circ}\text{F}$ . (closed)

Solubility:

very slightly soluble in water  
soluble in alcohol, ether, methyl  
alcohol, acetone, benzene, gasoline,  
and ethyl acetate

Additional Data:

coefficient of expansion,  
0.00117 per  $^{\circ}\text{C}$ .

#### DIISOBUTYLENE

Formula:  $(\text{CH}_3)_2\text{C}:\text{CHC}(\text{CH}_3)_3$

Formula Weight: 112.2

Melting Point:

$-106.5^{\circ}\text{C}$ .                                       $-101^{\circ}\text{C}$ .

Boiling Point:  $102.6^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.715(15/4)                                      0.721(20/4)

Heat of Fusion:

16.8 gram-calories per g. at  $15^{\circ}\text{C}$ .

Heat of Combustion:

1252.4 kg. cal./mole

Uses: organic syntheses

#### DIISOBUTYL PHTHALATE

Formula:  $\text{C}_6\text{H}_4(\text{COOC}_4\text{H}_9)_2$

Formula Weight: 278.3

Flash Point:  $322^{\circ}\text{F}$ . (closed)

Additional Data: vapor density, 9.58

#### DIISOPROPYLAMINE

Formula:  $[(\text{CH}_3)_2\text{CH}]_2\text{NH}$

Characteristics: amine odor

Formula Weight: 101.2

Melting Point:  $<-70^{\circ}\text{C}$ .

Boiling Point:

$83$  to  $84^{\circ}\text{C}$ . (at 760 mm.)

$83.5^{\circ}\text{C}$ . (at 743 mm.)

$80$  to  $85^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.722(22/0)                                      0.718(20/20)

Refractive Index: 1.395

Viscosity (centipoises): 0.40 at  $25^{\circ}\text{C}$ .

Flash Point:  $20^{\circ}\text{F}$ . (closed)

Solubility:

slightly soluble in water  
soluble in alcohol, ether, acetone,  
methyl alcohol, benzene, gasoline,  
and ethyl acetate

Additional Data:

coefficient of expansion,  
0.00186 per  $^{\circ}\text{C}$ .

#### 1, 2-DIISOPROPYLBENZENE

Synonyms: o-diisopropylbenzene

Formula:  $[(\text{CH}_3)_2\text{CH}]_2\text{C}_6\text{H}_4$

Formula Weight: 162.3

Boiling Point:  $209$  to  $210^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.858(25/25)

Solubility:

insoluble in                                       $\infty$  (in alcohol)  
water     $\infty$  (in ether)

#### 1, 3-DIISOPROPYLBENZENE

Synonyms: m-diisopropylbenzene

Formula:  $[(\text{CH}_3)_2\text{CH}]_2\text{C}_6\text{H}_4$

Formula Weight: 162.3

## 1,3-DIISOPROPYLBENZENE (Cont.)

Melting Point:  $-105^{\circ}\text{C}$ .Boiling Point:  $202^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.860

Solubility:

insoluble in	$\infty$ (in alcohol)
water	$\infty$ (in ether)

 $\alpha$ -DIISOPROPYLBENZENE

Synonyms:

Alkazene 12

a commercial mixture of isomers

Formula:  $[(\text{CH}_3)_2\text{CH}]_2\text{C}_6\text{H}_4$ 

Characteristics:

mild, pleasant alkyl benzene odor

Formula Weight: 162.3

Melting Point:  $< -65^{\circ}\text{C}$ .

Boiling Point:

 $203.3$  to  $206.3^{\circ}\text{C}$ . (at 760 mm.)  
 $5$  to  $95^{\circ}\text{F}$ 
Specific Gravity:  $0.871(25/25)$ Refractive Index:  $1.492$  at  $25^{\circ}\text{C}$ .

Viscosity (centipoises):

 $1.3$  at  $25^{\circ}\text{C}$ .       $0.8$  at  $60^{\circ}\text{C}$ .
Flash Point:  $170.6^{\circ}\text{F}$ . (closed)

Solubility:

insoluble in water	
$\infty$ (in benzene)	$\infty$ (in methyl
$\infty$ (in ether)	alcohol)
$\infty$ (in acetone)	$\infty$ (in V. M. P.
$\infty$ (in carbon	naphtha)
tetrachloride)	

Additional Data: fire point,  $174^{\circ}\text{F}$ .

## DIISOPROPYL PHTHALATE

Synonyms:

isopropyl phthalate

phthalic acid diisopropyl ester

Formula:  $\text{C}_6\text{H}_4[\text{COOCH}(\text{CH}_3)_2]_2$ 

Formula Weight: 250.3

Boiling Point:  $160$  to  $161^{\circ}\text{C}$ . (at 9 mm.)

Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## DIISOPROPYLZINC

Synonyms:

isodipropyl zinc      zinc diisopropyl

Formula:  $[(\text{CH}_3)_2\text{CH}]_2\text{Zn}$ 

Formula Weight: 151.6

Boiling Point:  $94$  to  $80^{\circ}\text{C}$ . (at 40 mm.)

Solubility:

decomposes in water
decomposes in alcohol

## DIKETENE

Synonyms: vinylaceto- $\beta$ -lactoneFormula:  $\text{C}_4\text{H}_6\text{O}_2$ 

Characteristics: pungent odor

Formula Weight: 84.1

Melting Point:  $-6.5^{\circ}\text{C}$ .Boiling Point:  $127.4^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

 $1.0897(20/20)$   
 $9.1$  lbs. per gal. at  $20^{\circ}\text{C}$ .
Flash Point:  $115^{\circ}\text{F}$ . (open)

Uses: organic syntheses

Solubility: decomposes in water

Additional Data: polymerizes on standing

## 1,3-DIMETHOXYBENZENE

Synonyms:

 $m$ -dimethoxybenzene

resorcinol dimethyl ether

Formula:  $\text{C}_6\text{H}_4(\text{OCH}_3)_2$ 

Formula Weight: 138.2

Melting Point:  $-52^{\circ}\text{C}$ .

Boiling Point:

 $216.5$  to  $217.7^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  
1.0803(0/4)                      1.062(15/15)

Solubility:  
very slightly soluble in water  
soluble in alcohol      soluble in ether

1,1-DIMETHOXYETHANE

Synonyms:  
acetaldehyde dimethyl acetal  
dimethyl acetal  
dimethyl aldehyde  
ethylidene dimethyl ether

Formula:  $\text{CH}_3\text{CH}(\text{OCH}_3)_2$

Characteristics:  
inflammable  
strong aromatic odor

Formula Weight: 90.1

Boiling Point:  
64.5° C. (at 760 mm.)  
64° C. (at 748 mm.)

Specific Gravity:  
0.850(20/4)                      0.8476(25/4)

Uses:  
organic syntheses      medicines

Solubility:  
soluble in chloroform  
 $\infty$  (in water)                       $\infty$  (in ether)  
 $\infty$  (in alcohol)

N,N-DIMETHYLACETAMIDE

Synonyms: acetdimethylamide

Formula:  $\text{CH}_3\text{CON}(\text{CH}_3)_2$

Formula Weight: 87.1

Boiling Point: 165.5° C. (at 754 mm.)

Specific Gravity: 0.943(20/4)

1,2-DIMETHYLAMINO BENZALDEHYDE

Formula:  $(\text{CH}_3)_2\text{NC}_6\text{H}_4\text{CHO}$

Characteristics:  
yellow                      oily

Formula Weight: 149.2

Boiling Point: 244° C. (at 760 mm.)

Solubility:  
soluble in dilute acids, alcohol, and ether

DIMETHYLAMINOETHANOL

Synonyms:  
2-dimethylaminoethanol  
 $\beta$ -dimethylaminoethyl alcohol  
dimethyl ethanolamine

Formula:  $(\text{CH}_3)_2\text{NCH}_2\text{CH}_2\text{OH}$

Characteristics:  
amine odor                      hygroscopic

Formula Weight: 89.1

Melting Point: < -70° C.

Boiling Point:  
131 to 135° C. (at 760 mm.)  
133.5° C. (at 760 mm.)

Specific Gravity:  
0.8866(20/4)                      0.887(20/20)  
7.4 lbs. per gal. at 20° C.

Refractive Index: 1.4300

Viscosity (centipoises): 3.4 at 25° C.

Flash Point:  
120° F. (open)                      88° F. (closed)

Uses:  
corrosion inhibitors  
dyes  
pharmaceuticals  
textile assistants

Solubility:  
 $\infty$  (of water)                       $\infty$  (in ether)  
 $\infty$  (in water)                       $\infty$  (in chloroform)  
 $\infty$  (in alcohol)                       $\infty$  (in benzene)

Additional Data:  
coefficient of expansion,  
0.00120 per ° C.

DIMETHYLAMINO-1,2-PROPANEDIOL

Synonyms:  
 $\alpha$ -dimethylaminoglycerol  
 $\gamma$ -dimethylaminopropylene glycol

Formula:  $(\text{CH}_3)_2\text{NCH}_2\text{CHOHCH}_2\text{OH}$

DIMETHYLAMINO-1,2-PROPANEDIOL  
(Cont.)

Characteristics: syrupy

Formula Weight: 119.2

Boiling Point: 220° C. (at 749 mm.)

Solubility:  
soluble in water, alcohol, ether, and  
chloroform

DIMETHYLANILINE

Synonyms:

N, N-dimethylaniline  
dimethylphenylamine

Formula:  $(\text{CH}_3)_2\text{NC}_6\text{H}_5$

Characteristics:  
yellow to brown      highly refractive  
oily                      pungent odor  
toxic

Formula Weight: 121.2

Melting Point:  
2.5° C.                      1.67° C.

Boiling Point:  
192.5 to 194° C. (at 760 mm.)

Specific Gravity:  
0.9557(20/4)              0.956(25/25)  
8.0 lbs. per gal. at 20° C.

Refractive Index: 1.5582

Surface Tension (dynes per cm.):  
37.7 at 10° C.              27.6 at 100° C.  
36.56 at 20° C.

Viscosity (centipoises): 1.285 at 25° C.

Flash Point:  
170° F. (open)              145° F. (closed)

Specific Heat (gram-cals. per g.  
per ° C.): 0.42 at 0 to 20° C.

Heat of Vaporization:  
80.8 g. cals. per g. at 15° C.  
145.5 Btu. per lb. at boiling point

Heat of Combustion (kg. cals. per mole):  
1142.7 (liquid)

Uses:

chemical and methylating agent  
dyes                      vanillin  
commercial solvent

Solubility:

insoluble in water  
soluble in ether, alcohol, chloroform,  
and carbon tetrachloride  
soluble in most common organic  
solvents

Additional Data:

critical temperature, 415° C.  
critical pressure, 35.8 atm.  
autoignition temperature, 700° F.  
vapor density, 4.17

DIMETHYLARSINE

Synonyms: cacodyl hydride

Formula:  $(\text{CH}_3)_2\text{AsH}$

Formula Weight: 106.0

Boiling Point:  
36° C. (at 760 mm.)  
35.6° C. (at 747 mm.)

Specific Gravity: 1.213(29/4)

Solubility:  
∞ (in alcohol)              ∞ (in benzene)  
∞ (in ether)              ∞ (in carbon  
∞ (in chloroform)              disulfide)

Additional Data: ignites in air

N-DIMETHYLBENZYLAMINE

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{N}(\text{CH}_3)_2$

Formula Weight: 135.2

Boiling Point: 183 to 184° C. (at 765 mm.)

Specific Gravity: 0.915 at 0° C.

Solubility:

slightly soluble in cold water  
very slightly soluble in hot water  
∞ (in alcohol)              ∞ (in ether)

## 2, 3-DIMETHYL-1, 3-BUTADIENE

## Synonyms:

biisopropenyl      diisopropenyl

Formula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{C}(\text{CH}_3):\text{CH}_2$

Formula Weight: 82.1

Melting Point:  $-65^\circ\text{C}$ .

## Boiling Point:

$69.6^\circ\text{C}$ . (at 760 mm.)

$69.5^\circ\text{C}$ . (at 750 mm.)

## Specific Gravity:

0.7446(0/0)      0.727(20/20)

Refractive Index: 1.4377

## 2, 2-DIMETHYLBUTANE

## Synonyms:

ethyltrimethyl-      hexane  
methane      neohexane

Formula:  $(\text{CH}_3)_3\text{CC}_2\text{H}_5$

Formula Weight: 86.2

## Melting Point:

$-98.2^\circ\text{C}$ .       $-99.8^\circ\text{C}$ .

Boiling Point:  $49.7^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.649(20/20)      0.6487(20/4)

Refractive Index: 1.3657

Specific Heat (Btu./lb./ $^\circ\text{F}$ .):

0.511 at  $80.4^\circ\text{F}$ .

## Heat of Vaporization:

132.66 Btu. per lb. at boiling point

138.13 Btu. per lb. at  $77^\circ\text{F}$ .

## Heat of Combustion:

112,620 Btu. per gal. (gross),

104,200 Btu. per gal. (net), liquid

20,855 Btu. per lb. (gross),

19,500 Btu. per lb. (net), gas

## Solubility:

insoluble in      soluble in alcohol  
water      soluble in ether

## Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 2.9749

specific gravity of liquid (in vacuo),

0.64917(20/4) $^\circ\text{C}$ . 0.65399(60/60) $^\circ\text{F}$ .

liquid density (in vacuo) at  $60^\circ\text{F}$ .,

5.4524

API gravity at  $60^\circ\text{F}$ ., 84.9

aniline point,  $177.8^\circ\text{F}$ .

critical temperature,  $422^\circ\text{F}$ .

critical pressure, 441 psia.

octane number,

motor, 93.4

research, 91.8

coefficient of expansion,

0.00081 at 60 to  $77^\circ\text{F}$ .

23.95 cu. ft. per gal. of liquid

total heating values (at  $77^\circ\text{F}$ .),

20,698 Btu.-lb.,

111,320 Btu./cu. ft.-gas

## 2, 3-DIMETHYLBUTANE

## Synonyms:

biisopropyl

diisopropyl

dimethylisopropylmethane

hexane

Formula:  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$

Formula Weight: 86.2

Melting Point:  $-135.1$  to  $-128^\circ\text{C}$ .

Boiling Point:  $58.1^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.668(17/4)

0.662(20/4)

Refractive Index: 1.3783

Specific Heat (Btu./lb./ $^\circ\text{F}$ .):

0.513 at  $80.4^\circ\text{F}$ .

## Heat of Vaporization:

137.67 Btu. per lb. at boiling point

145.29 Btu. per lb. at  $77^\circ\text{F}$ .

## Heat of Combustion:

115,220 Btu. per gal. (gross),

106,620 Btu. per gal. (net), liquid

20,890 Btu. per lb. (gross),

19,340 Btu. per lb. (net), gas

## 2,3-DIMETHYLBUTANE (Cont.)

## Solubility:

insoluble in water	soluble in alcohol soluble in ether
-----------------------	--

## Additional Data:

specific gravity of gas (ideal)  
(air = 1.0), 2.9749  
specific gravity of liquid (in vacuo),  
0.66164(20/4)<sup>o</sup>C. 0.66639(60/60)<sup>o</sup>F.  
API gravity at 60<sup>o</sup>F., 80.8  
liquid density (in vacuo) at 60<sup>o</sup>F.,  
5.5558  
24.45 cu. ft. gas/gal. of liquid  
aniline point, 161.4<sup>o</sup>F.  
critical temperature, 227.4<sup>o</sup>C.  
critical pressure, 30.7 atm.  
coefficient of expansion,  
0.00078 at 60 to 77<sup>o</sup>F.  
total heating values (at 77<sup>o</sup>F.),  
20,730 Btu./lb.,  
113,660 Btu./cu. ft.-gas  
octane number, motor 94.3

## 2,3-DIMETHYL-2-BUTANOL

Synonyms: hexyl alcohol

Formula:  $(\text{CH}_3)_2\text{CHC}(\text{CH}_3)_2\text{OH}$ 

Formula Weight: 102.2

Melting Point: -14<sup>o</sup>C.Boiling Point: 120 to 121<sup>o</sup>C. (at 760 mm.)

Specific Gravity: 0.821(20/0)

## Solubility:

very slightly	$\infty$ (in alcohol)
soluble in water	$\infty$ (in ether)

## 2,2-DIMETHYL-3-BUTANOL

Synonyms: hexyl alcohol

Formula:  $(\text{CH}_3)_3\text{CCHOHCH}_3$ 

Formula Weight: 102.2

Melting Point: 5.5<sup>o</sup>C.Boiling Point: 120 to 121<sup>o</sup>C. (at 760 mm.)Specific Gravity: 0.812 at 25<sup>o</sup>C.

## Solubility:

very slightly	$\infty$ (in alcohol)
soluble in water	$\infty$ (in ether)

## 2,2-DIMETHYL-4-BUTANOL

Synonyms: hexyl alcohol

Formula:  $(\text{CH}_3)_3\text{CCH}_2\text{CHOH}$ 

Characteristics: oily

Formula Weight: 102.2

Melting Point: -60<sup>o</sup>C.

## Solubility:

very slightly	$\infty$ (in alcohol)
soluble in water	$\infty$ (in ether)

## 2,3-DIMETHYL-1-BUTENE

Synonyms: hexylene

Formula:  $(\text{CH}_3)_2\text{CHC}(\text{CH}_3):\text{CH}_2$ 

Formula Weight: 84.2

Melting Point: -140.1<sup>o</sup>C.Boiling Point: 55.6<sup>o</sup>C. (at 760 mm.)Specific Gravity: 0.678 at 20<sup>o</sup>C.

## Solubility: insoluble in water

$\infty$ (in alcohol)	$\infty$ (in carbon disulfide)
$\infty$ (in ether)	

## 3,3-DIMETHYL-1-BUTENE

Synonyms: hexylene

Formula:  $(\text{CH}_3)_3\text{CCH}:\text{CH}_2$ 

Formula Weight: 84.2

Melting Point: -115.5<sup>o</sup>C.Boiling Point: 41.2<sup>o</sup>C. (at 760 mm.)Specific Gravity: 0.653 at 20<sup>o</sup>C.

## Solubility: insoluble in water

## 2,3-DIMETHYL-2-BUTENE

Synonyms: hexylene

Formula:  $(\text{CH}_3)_2\text{C}:\text{C}(\text{CH}_3)_2$ 

Formula Weight: 84.2

Melting Point:  $-75.4^{\circ}\text{C}$ .

Boiling Point:  $73.2^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.712 at  $20^{\circ}\text{C}$ .

Solubility:

soluble in ether      soluble in acetone

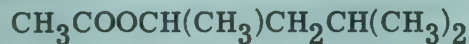
### 1,3-DIMETHYLBUTYL ACETATE

Synonyms:

methylamyl acetate

1-methylisoamyl acetate

Formula:



Formula Weight: 144.1

Boiling Point:  $140$  to  $147^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

$0.857$  at  $20^{\circ}\text{C}$ .

$7.13$  lbs. per gal. at  $20^{\circ}\text{C}$ .

Refractive Index: 1.4008

Flash Point:  $113^{\circ}\text{F}$ . (closed)

Solubility (grams per 100 ml.):

$0.89$  (of water)       $0.08$  (in water)

Additional Data:

coefficient of expansion,

$0.00109$  at  $10$  to  $30^{\circ}\text{C}$ .

dilution ratios,

with toluene . . . . .  $1.7$

with petroleum naphtha . . . .  $1.0$

with xylene . . . . .  $1.6$

with mineral spirits . . . . .  $0.8$

### 1,3-DIMETHYLBUTYLAMINE

Synonyms: 2-amino-4-methylpentane

Formula:  $\text{CH}_3\text{CHNH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

Characteristics: amine odor

Formula Weight: 101.2

Melting Point:  $<-65^{\circ}\text{C}$ .

Boiling Point:  $106$  to  $109^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  $0.747(20/20)$

Refractive Index:  $1.409$

Viscosity (centipoises):  $0.60$  at  $25^{\circ}\text{C}$ .

Flash Point:  $55^{\circ}\text{F}$ . (open)

Solubility:

insoluble in water

soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and  
ethyl acetate

### $\alpha, \alpha$ -DIMETHYLBUTYRIC ACID

Synonyms:

2,2-dimethylbutanoic acid

dimethylethylacetic acid

ethyl dimethylacetic acid

Formula:  $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{COOH}$

Formula Weight: 116.2

Melting Point:  $-14^{\circ}\text{C}$ .

Boiling Point:  $187^{\circ}\text{C}$ . (at 760 mm.)

Solubility:

very slightly      soluble in alcohol  
soluble in water      soluble in ether

### $\alpha, \beta$ -DIMETHYLBUTYRIC ACID

Synonyms:

2,3-dimethylbutanoic acid

isopropylmethylacetic acid

Formula:  $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{COOH}$

Formula Weight: 116.2

Boiling Point:  $189$  to  $191^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  $0.928(15/4)$

Solubility:

soluble in water, alcohol, and ether

### DIMETHYL "CELLOSOLVE"

Synonyms:

ethylene glycol dimethyl ether

Formula:  $\text{CH}_3\text{OC}_2\text{H}_4\text{OCH}_3$

Formula Weight: 90.1

Freezing Point:  $-71^{\circ}\text{C}$ .

Boiling Point:

$85.2^{\circ}\text{C}$ . (at 760 mm.)

$16.0^{\circ}\text{C}$ . (at 50 mm.)

$-14^{\circ}\text{C}$ . (at 5 mm.)

## DIMETHYL "CELLOSOLVE" (Cont.)

Vapor Pressure (mm. Hg): 61.2 at 20° C.

Specific Gravity:

0.8692(20/20)7.23 lbs. per gal. at 20° C.Flash Point: 40° F. (open)

Uses:

lubricant                      plasticizer  
commercial solvent  
inert reaction or extraction medium

Solubility:

∞ (of water)                      ∞ (in water)  
completely miscible with alcohol,  
acetone, 1,2-dichloroethane, ethyl  
acetate, toluene, heptane, castor oil,  
pine oil, and isopropyl ether

## DIMETHYL "CELLOSOLVE" ADIPATE

Synonyms: dimethoxy ethyl adipate

Formula:  $[(CH_2)_2COO(CH_2)_2OCH_3]_2$ 

Formula Weight: 262.3

Boiling Point: 194 to 196° C. (at 20 mm.)

DIMETHYL "CELLOSOLVE"  
CARBONATE

Synonyms: dimethoxy ethyl carbonate

Formula:  $[CH_3O(CH_2)_2O]_2CO$ 

Formula Weight: 178.2

Boiling Point: 115 to 117° C. (at 13 mm.)

DIMETHYL "CELLOSOLVE"  
PHTHALATE

Synonyms:

dimethoxy ethyl phthalate  
dimethyl glycol phthalate  
Methox  
methyl glycol phthalate

Formula:  $C_6H_4(COOC_2H_4OCH_3)_2$ 

Characteristics:

slight, moderate, characteristic odor

Formula Weight: 282.3

Melting Point: -40° C.

Boiling Point: 178 to 180° C. (at 1 mm.)

## DIMETHYL "CELLOSOLVE" PHTHALATE

Specific Gravity:

1.171(20/20)9.75 lbs. per gal. at 20° C.

Refractive Index: 1.500 at 25° C.

Flash Point: 356° F. (closed)

Uses:

solvent for cellulose acetate, cellulose  
acetobutyrate, cellulose acetopro-  
pionate, ethyl cellulose, glypthals,  
nitrocellulose, Parlon, and Vinylite

Solubility:

3.4% at 25° C. (of water)

0.09% at 25° C. (in water)2% by volume in 60° B $\acute{e}$ . gasoline  
at 20° C.,

0.3 cc. in 100 cc. at 25° C.

(in mineral oil)

insoluble or limited solubility in  
glycerol, glycol and certain amines  
soluble in most other organic solvents  
increasingly insoluble in turpentine as  
the temperature is lowered below  
30° C.

dissolves most common resins

Additional Data:

fire point, 421° F.

volatility at 105° C.,

0.75% after 24 hours,5.0% after 100 hours

evaporation rate at 105° C.,

0.0015 g. loss/sq. cm. after 24 hours0.0095 g. loss/sq. cm. after 100 hours

## DIMETHYL CITRACONATE

Synonyms:

citraconic acid dimethyl ester  
methyl citraconate

Formula:  $CH_3C(COOCH_3)CHCOOCH_3$ 

Characteristics: oily

Formula Weight: 158.2

Boiling Point: 210.5° C. (at 760 mm.)

Specific Gravity: 1.121(15/15)

Solubility (grams per 100 ml.):  
3 at 15°C. (in water)

### 1, 2-DIMETHYLCYCLOHEXANE

Synonyms:

o-dimethylcyclohexane  
hexahydro-o-xylene

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_{10}$

Formula Weight: 112.2

Melting Point:

-57.5°C.                      -85°C.

Boiling Point:

129.4°C. (at 760 mm.)

121°C. (at 760 mm.)

Specific Gravity:

0.779(20/4)                      0.792

Uses: organic syntheses

Solubility:

insoluble in                       $\infty$  (in alcohol)  
water                                   $\infty$  (in ether)

Additional Data: aniline equivalent, 6

### 1, 3-DIMETHYLCYCLOHEXANE

Synonyms:

m-dimethylcyclohexane  
hexahydro-m-xylene

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_{10}$

Formula Weight: 112.2

Melting Point: -85°C.

Boiling Point:

121°C. (at 760 mm.) cis

119°C. (at 756 mm.) trans

Specific Gravity:

0.776                                  0.7735(20/4) cis  
0.772(20/4) trans

Refractive Index:

1.4269 cis                                  1.4254 trans

Uses: organic syntheses

Solubility:

insoluble in                       $\infty$  (in alcohol)  
water                                   $\infty$  (in ether)

Additional Data: aniline equivalent, 4

### 1, 4-DIMETHYLCYCLOHEXANE

Synonyms:

p-dimethylcyclohexane  
hexahydro-p-xylene  
Hexahydroxylol

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_{10}$

Formula Weight: 112.2

Melting Point: -86°C.

Boiling Point:

120.5°C. (at 760 mm.)

119 to 120°C. (at 760 mm.)

Specific Gravity:

0.777                                  0.7671(20/4) cis  
0.7638(20/4) trans

Flash Point: 52°F. (closed)

Uses: organic syntheses

Additional Data:

vapor density, 3.86  
aniline equivalent, 6

### DIMETHYLDIOXANE

Formula:  $\text{CH}_3\text{CHCH}_2\text{OCH}_2(\text{CH}_3)\text{CHO}$

Formula Weight: 116.2

Boiling Point: 117.5°C. (at 760 mm.)

Specific Gravity:

0.9268(20/20)  
7.7 lbs. per gal. at 20°C.

Flash Point: 75°F. (open)

Uses:

extractant and commercial solvent for  
cellulose derivatives, dyes, fats,  
oils, and waxes

Solubility:

1.55% by weight (of water)  
4.33% by weight (in water)

## DIMETHYLETHYLAMINE

Formula:  $(\text{CH}_3)_2\text{NC}_2\text{H}_5$ 

Formula Weight: 73.1

Boiling Point: 37.5° C. (at 760 mm.)

## DIMETHYLFORMAMIDE

Synonyms: DMF

Formula:  $\text{HCON}(\text{CH}_3)_2$ 

Characteristics:

colorless                      mobile

Formula Weight: 73.1

Freezing Point: -61° C.

Boiling Point: 153° C.

Vapor Pressure (mm. Hg):  
3.7 mm. at 25° C.

Specific Gravity: 0.9445(25/4)

Viscosity (centipoises): 0.802 at 25° C.

Flash Point: 153° F. (open)

Uses:

gas solvent  
carrier solvent for gases  
inert reaction medium

Solubility:

miscible with water and most common  
organic solvents

Additional Data:

## GAS SOLUBILITIES IN DMF

(Volumes gas (0° C., 1 atm.) per volume  
DMF at 25° C. and gas partial pressure of  
one atmosphere unless otherwise stated.)

GAS	VOL./VOL.
Hydrogen Cyanide	> 3,000 (30° C.)
Hydrogen Bromide	680 (0° C.)
Hydrogen Chloride	590
Sulphur Dioxide	405
Chlorine	385 (0° C.)
Boron Fluoride	385 (0° C.)
Diacetylene	145 (100 mm)
1,3-Butadiene	61
Hydrogen Sulfide	35
Vinylacetylene	35 (100 mm)
Acetylene	31

Ammonia	31
1-Butene	22
Propylene	8.2
Methylacetylene	8.0 (100 mm)
Carbon Dioxide	4.4
Acetylene	4.2 (100 mm)
Propane	4.0
Ethane	1.5
Ethylene	1.3
Methane	0.3
Oxygen	0.1
Carbon monoxide	0.06
Hydrogen	0.04
Nitrogen	0.04

## 2,5-DIMETHYLFURAN

Synonyms:

 $\alpha$ ,  $\alpha'$ -dimethylfuran  
2,5-dimethylfuranFormula:  $\text{OC}(\text{CH}_3):\text{CHCH}:\text{C}(\text{CH}_3)$ 

Formula Weight: 96.1

Boiling Point: 93 to 94° C. (at 760 mm.)

Specific Gravity:

0.888(20/4)                      0.8900(20/20)  
0.9026(17.7/4)  
7.4 lbs. per gal. at 20° C.

Refractive Index: 1.4363

Flash Point: 45° F. (open)

Uses:

organic syntheses      leather tanning

Solubility:

insoluble (of water)  
insoluble (in water)  
very soluble in alcohol  
very soluble in ether  
soluble in chloroform, benzene, acetic  
acid, and alkalis

## 2,6-DIMETHYL-1,3-HEPTADIENE

Synonyms:

isogeraniol                      isogeraniole

Formula:

 $\text{CH}_2:\text{C}(\text{CH}_3)\text{CH}:\text{CHCH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 124.2

Boiling Point: 143 to 145° C. (at 755 mm.)

Specific Gravity: 0.765(10/4)

Solubility: insoluble in water

### 2, 4-DIMETHYLHEPTANE

Synonyms: nonane

Formula:



Formula Weight: 128.3

Boiling Point: 133° C. (at 752 mm.)

Specific Gravity: 0.717(20/4)

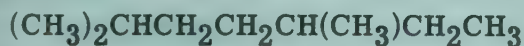
Solubility:

insoluble in water     $\infty$  (in ether)

### 2, 5-DIMETHYLHEPTANE

Synonyms: nonane

Formula:



Formula Weight: 128.3

Boiling Point: 135.8° C. (at 760 mm.)

Specific Gravity: 0.714(20/4)

### 2, 6-DIMETHYLHEPTANE

Synonyms:

diisobutylmethane    nonane  
isobutylisoamyl

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{CH}(\text{CH}_3)_2$

Formula Weight: 128.3

Boiling Point: 132 to 133° C. (at 760 mm.)

Specific Gravity:

0.7247(0/4)                      0.712(20/0)

Solubility:

insoluble in water    soluble in ether  
insoluble in alcohol

### 2, 6-DIMETHYL-4-HEPTANOL

Synonyms:

diisobutylcarbinol    nonyl alcohol  
diisobutylmethanol

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2]_2\text{CHOH}$

Formula Weight: 144.3

Boiling Point: 172 to 174° C. (at 750 mm.)

Specific Gravity:

0.8155(12/4)                      0.8237(0/4)

Refractive Index: 1.423 at 21° C.

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

### 2, 6-DIMETHYL-4-HEPTANONE

Synonyms:

diisobutyl ketone  
s-diisopropylacetone  
isovalerone  
valerone

Formula:  $[(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2]_2\text{CO}$

Characteristics: oily

Formula Weight: 142.2

Melting Point: -46.4° C.

Boiling Point:

165 to 168° C. (at 760 mm.)

168.1° C. (at 760 mm.)

164 to 169° C. (at 760 mm.)

Specific Gravity:

0.806(20/4)                      0.8089(20/20)  
6.7 lbs. per gal. at 20° C.

Refractive Index: 1.412 at 21° C.

Flash Point: 140° F. (open)

Heat of Vaporization:

69.6 gram-calories per g.

Uses:

coating compositions  
lacquers  
organic syntheses  
plasticizer  
commercial solvent for nitrocellulose,  
roll coating inks, rubber, stains,  
and synthetic resins

Solubility:

0.45% (of water) by weight at 20° C.

<0.06% (in water) by weight at 20° C.

$\infty$  (in alcohol)                       $\infty$  (in ether)

miscible with most organic liquids

## 2,6-DIMETHYL-4-HEPTANONE (Cont.)

## Additional Data:

azeotrope with water boils at 97.3° C.

and contains 51.0% of water

coefficient of expansion,

0.000570 per ° F.,

0.00102 per ° C. at 10 to 30° C.

dilution ratios,

with xylene . . . . . 1.5

with mineral spirits . . . . . 0.6

Viscosity (% wt. of RS  
1/2 sec. Nitrocellulose)

	5%	10%	15%	20%
Centipoises (20° C.)	<u>20.9</u>	<u>212</u>	<u>1140</u>	<u>11,280</u>

## 2,5-DIMETHYL-1,5-HEXADIENE

Formula:  $[\text{CH}_2\text{:C}(\text{CH}_3)\text{CH}_2]_2$ 

Formula Weight: 110.2

Boiling Point: 113 to 114° C. (at 755 mm.)

Specific Gravity: 0.749(21/21)

Solubility: insoluble in water

## 2,5-DIMETHYL-2,4-HEXADIENE

Synonyms: diisocrotyl

Formula:  $(\text{CH}_3)_2\text{C:CHCH:C}(\text{CH}_3)_2$ 

Formula Weight: 110.2

Melting Point: -91.3° C.

Boiling Point: 102.5° C. (at 756 mm.)

Specific Gravity: 0.7158(21/4)

Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## 2,3-DIMETHYLHEXANE

Synonyms:

isopropylmethylpropylmethane  
octaneFormula:  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{C}_2\text{H}_5$ 

Formula Weight: 114.2

Boiling Point:

115.8° C. (at 760 mm.)

113.9° C. (at 760 mm.)

Specific Gravity:

0.712(20/4)                      0.7240(20/4)

Refractive Index: 1.4093

Solubility:

insoluble in water

slightly soluble in alcohol

soluble in ether

## 2,4-DIMETHYLHEXANE

Synonyms:

ethylisobutylmethylmethane  
octaneFormula:  $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 114.2

Boiling Point: 109.8° C. (at 760 mm.)

Specific Gravity:

0.703(20/4)                      0.7077(20/4)

Refractive Index: 1.4026

Solubility:

insoluble in water

slightly soluble in alcohol

soluble in ether

## 2,5-DIMETHYLHEXANE

Synonyms:

biisobutyl                      octane  
diisobutylFormula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 114.2

Melting Point: -91° C.

Boiling Point:

108.3° C. (at 760 mm.)

109.2° C. (at 760 mm.)

Specific Gravity: 0.6985(20/4)

Refractive Index: 1.3929

Heat of Vaporization:

123.5 Btu. per lb. at the boiling point

142.9 Btu. per lb. at 77° F.

Heat of Combustion (kg.-cals. per mole):  
1303.3 (liquid)

**Solubility:**

insoluble (of water)  
slightly soluble in water  
soluble in alcohol

**Additional Data:**

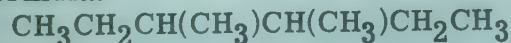
specific gravity of gas (ideal)  
(air = 1.0), 3.9434  
specific gravity of liquid (in vacuo),  
0.69355(20/4)<sup>o</sup>C. 0.69795(60/60)<sup>o</sup>F.  
liquid density (in vacuo) at 60<sup>o</sup>F.,  
5.8190  
API gravity at 60<sup>o</sup>F., 71.2  
aniline point, 172.0<sup>o</sup>F.  
critical temperature, 530.2<sup>o</sup>F.  
critical pressure, 360.8 psia.  
coefficient of expansion,  
0.00066 at 32 to 86<sup>o</sup>F.  
total heating values (at 77<sup>o</sup>F.),  
20,551 Btu./lb.,  
118,230 Btu./cu. ft.-gas

**3, 4-DIMETHYLHEXANE**

**Synonyms:**

bi-sec-butyl  
sec-butylethylmethylethane  
octane

**Formula:**



**Formula Weight:** 114.2

**Boiling Point:**

116.5<sup>o</sup>C. (at 760 mm.)  
117.9<sup>o</sup>C. (at 760 mm.)

**Specific Gravity:** 0.7210(20/4)

**Refractive Index:** 1.4058

**Heat of Combustion (kg.-cals. per mole):**  
1303.7 (liquid)

**Solubility:**

soluble in water      soluble in ether  
slightly soluble in alcohol

**1, 2-DIMETHYLHYDRAZINE**

**Synonyms:**

hydrazomethane  
sym-dimethylhydrazine

**Formula:**  $\text{CH}_3\text{NHNHCH}_3$

**Formula Weight:** 60.1

**Boiling Point:** 81<sup>o</sup>C. (at 747 mm.)

**Specific Gravity:** 0.827(20/4)

**Solubility:**

$\infty$  (in water)       $\infty$  (in ether)  
 $\infty$  (in alcohol)

**1, 1-DIMETHYLHYDRAZINE**

**Synonyms:** uns-dimethylhydrazine

**Formula:**  $(\text{CH}_3)_2\text{NNH}_2$

**Formula Weight:** 60.1

**Boiling Point:** 62.5<sup>o</sup>C. (at 717 mm.)

**Specific Gravity:** 0.791 at 22<sup>o</sup>C.

**Solubility:**

very soluble in water, alcohol, and  
ether

**DIMETHYLKETENE**

**Formula:**  $(\text{CH}_3)_2\text{C}:\text{CO}$

**Characteristics:** yellow

**Formula Weight:** 70.1

**Melting Point:** -97.5<sup>o</sup>C.

**Boiling Point:** 34<sup>o</sup>C. (at 750 mm.)

**Solubility:**

decomposes in water  
decomposes in alcohol  
soluble in ether

**DIMETHYLMERCURY**

**Synonyms:** mercury dimethyl

**Formula:**  $(\text{CH}_3)_2\text{Hg}$

**Formula Weight:** 230.7

**Boiling Point:** 95 to 96<sup>o</sup>C. (at 760 mm.)

**Specific Gravity:**

2.954(22/4)      3.069

**Solubility:**

very slightly soluble in water  
very soluble in alcohol  
very soluble in ether

## 1,4-DIMETHYLNAPHTHALENE

Synonyms: d-dimethylnaphthaleneFormula:  $(\text{CH}_3)_2\text{C}_{10}\text{H}_6$ 

Formula Weight: 156.2

Melting Point:  $-18^\circ\text{C}$ .Boiling Point:  $264.3^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.016(20/4)

Refractive Index: 1.61567 at  $16^\circ\text{C}$ .N,N-DIMETHYL-o-NITROANILINESynonyms: m-nitrodimethylanilineFormula:  $\text{NO}_2\text{C}_6\text{H}_4\text{N}(\text{CH}_3)_2$ 

Characteristics: yellow

Formula Weight: 166.2

Boiling Point:  $151$  to  $153^\circ\text{C}$ . (at 30 mm.)

Specific Gravity: 1.179(20/4)

Solubility:

slightly soluble in water

very soluble in alcohol

 $\infty$  (in ether)

## 2,6-DIMETHYL-2-NITROHEPTANE

Synonyms:

2-nitro-2,6-dimethylheptane

nitrononane

Formula:  $(\text{CH}_3)_2\text{C}(\text{NO}_2)(\text{CH}_2)_3\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 173.2

Boiling Point:  $113$  to  $114^\circ\text{C}$ . (at 25 mm.)

Specific Gravity: 0.915(18/4)

## 2,5-DIMETHYL-1-NITROHEXANE

Synonyms:

1-nitro-2,5-dimethylhexane

nitrooctane

Formula:

 $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{CH}(\text{CH}_3)\text{CH}_2\text{NO}_2$ 

Formula Weight: 159.2

Boiling Point:  $100$  to  $105^\circ\text{C}$ . (at 20 mm.)

## 2,7-DIMETHYL-1-NITROOCTANE

Synonyms:

1-nitrodecane

1-nitro-2,7-dimethyloctane

Formula:

 $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_4\text{CH}(\text{CH}_3)\text{CH}_2\text{NO}_2$ 

Formula Weight: 187.3

Boiling Point:

 $235$  to  $237^\circ\text{C}$ . (at 760 mm.)

decomposes

Specific Gravity: 0.925(21/0)

## 2,7-DIMETHYL-2-NITROOCTANE

Synonyms:

2-nitrodecane

2-nitro-2,7-dimethyloctane

Formula:  $(\text{CH}_3)_2\text{C}(\text{NO}_2)(\text{CH}_2)_4\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 187.3

Boiling Point:

 $235$  to  $237^\circ\text{C}$ . (at 749 mm.) decomposes

Specific Gravity: 0.909(20/4)

## 2,4-DIMETHYL-2-NITROPENTANE

Synonyms:

2-nitro-2,4-dimethylpentane

nitroheptane

Formula:  $(\text{CH}_3)_2\text{CNO}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 145.2

Boiling Point:  $181$  to  $182^\circ\text{C}$ . (at 742 mm.)

Specific Gravity: 0.956(0/0)

## 2,2-DIMETHYL-3-NITROPENTANE

Synonyms:

3-nitro-2,2-dimethylpentane

nitroheptane

Formula:  $(\text{CH}_3)_2\text{CCH}(\text{NO}_2)\text{C}_2\text{H}_5$ 

Formula Weight: 145.2

Boiling Point:  $89$  to  $90^\circ\text{C}$ . (at 40 mm.)

Specific Gravity: 0.940(20/20)

**3,7-DIMETHYL-1,6-OCTADIENE**

Synonyms: linaloolene

Formula:  $C_{10}H_{18}$ 

Formula Weight: 138.3

Boiling Point: 165 to 168°C. (at 760 mm.)

Specific Gravity: 0.788 at 20°C.

**2,6-DIMETHYL-2,6-OCTADIENE**

Synonyms: dihydromyrcene

Formula:  $C_{10}H_{18}$ 

Formula Weight: 138.3

Boiling Point:

171.5 to 173.5°C. (at 760 mm.)

Specific Gravity: 0.775(21/4)

**2,6-DIMETHYLOCTANE**

Synonyms: decane

Formula:  $(CH_3)_2CH(CH_2)_3CH(CH_3)C_2H_5$ 

Formula Weight: 142.3

Boiling Point: 159.0°C. (at 760 mm.)

Specific Gravity: 0.730(20/4)

**2,7-DIMETHYLOCTANE**

Synonyms:

biisoamyl

decane

diisoamyl

Formula:  $(CH_3)_2CH(CH_2)_4CH(CH_3)_2$ 

Formula Weight: 142.3

Melting Point: -52.8°C.

Boiling Point: 159.7°C. (at 760 mm.)

Specific Gravity:

0.725(20/4)

0.7479 at 20°C.

Refractive Index:

1.4092 at 18.1°C.

1.41049 at 15°C.

Solubility:

insoluble in water

soluble in alcohol, ether, and acetic acid

**3,7-DIMETHYL-1-OCTANOL (i)**

Synonyms: tetrahydrogeraniol

Formula:

 $(CH_3)_2CH(CH_2)_3CH(CH_3)CH_2CH_2OH$ 

Formula Weight: 158.3

Boiling Point: 221 to 223°C. (at 760 mm.)

Specific Gravity: 0.8333 at 15°C.

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

**2,6-DIMETHYL-6-OCTANOL**

Synonyms: linalool tetrahydride

Formula:  $C_{10}H_{22}O$ 

Formula Weight: 158.3

Boiling Point: 196 to 197°C. (at 760 mm.)

Specific Gravity: 0.836(15/4)

**2,6-DIMETHYL-8-OCTANOL**

Synonyms: geraniol tetrahydride

Formula:  $C_{10}H_{22}O$ 

Formula Weight: 158.3

Boiling Point: 212 to 213°C. (at 760 mm.)

Specific Gravity: 0.849(0/4)

**2,2-DIMETHYLPENTANE**

Synonyms:

heptane

trimethylpropylmethane

Formula:  $(CH_3)_3CCH_2C_2H_5$ 

Formula Weight: 100.2

Melting Point:

-125°C.

freezes at -124°C.

Boiling Point:

78.9 to 79.2°C. (at 760 mm.)

Specific Gravity: 0.674(20/4)

Refractive Index: 1.3823

## 2,2-DIMETHYLPENTANE (Cont.)

Specific Heat (Btu. per lb. per °F.):  
0.518 at 70° F. (liquid)

Heat of Vaporization (Btu. per lb.):  
125.3 at the boiling point  
139.15 at 77° F.

Heat of Fusion (gram-calories per g.):  
14.0 at 15° C.

Heat of Combustion (kilogram-calories per mole): 1148.9 (liquid)

Uses: organic syntheses

Solubility:  
insoluble in water    soluble in alcohol

## Additional Data:

C. S.T. aniline, 78.3° C.

specific gravity of gas (ideal)  
(air = 1.0), 3.4592

specific gravity of liquid (in vacuo),  
0.67386(20/4)° C. 0.67833(60/60)° F.

API gravity at 60° F., 77.1

liquid density (in vacuo) at 60° F.,  
5.6554

critical temperature, 477.9° F.

critical pressure, 417 psia.

coefficient of expansion,  
0.00070 at 68° F.

total heating values (at 77° F.),  
20,607 Btu./lb.,  
115,140 Btu./cu. ft.-gas

## 2,3-DIMETHYLPENTANE

## Synonyms:

ethylisopropylmethylethane  
heptane

Formula:  $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

Formula Weight: 100.2

Melting Point: -135° C.

Boiling Point: 89.4° C. (at 760 mm.)

Specific Gravity: 0.6959

Specific Heat (Btu. per lb. per °F.):  
0.510 at 64.9° F. (liquid)

Heat of Vaporization (Btu. per lb.):  
131.1 at the boiling point  
146.92 at 77° F.

Heat of Combustion (kilogram-calories per mole): 1148.9 (liquid)

Uses: organic syntheses

## Solubility:

insoluble in water    soluble in alcohol  
very soluble in ether

## Additional Data:

critical temperature, 508.3° F.

critical pressure, 429 psia.

coefficient of expansion,  
0.00068 at 68° F.

total heating values (at 77° F.)  
Btu. per lb., 20629

Btu. per cu. ft. (gas) —

Btu. per gal. (liquid), 118940

specific gravity of gas (ideal)  
(air = 1.0), 3.4592

specific gravity of liquid (in vacuo),  
0.69512(20/4)° C. 0.6995(60/60)° F.

API gravity at 60° F., 70.8

liquid density (in vacuo) at 60° F.,  
5.8323

## 3,3-DIMETHYLPENTANE

## Synonyms:

diethyldimethylmethane  
heptane

Formula:  $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_3$

Formula Weight: 100.2

Melting Point: -134.9° C.

Boiling Point: 86.0° C. (at 760 mm.)

Specific Gravity: 0.6934

Refractive Index: 1.3910

Specific Heat (Btu. per lb. per °F.):  
0.505 at 67.8° F. (liquid)

Heat of Vaporization (Btu. per lb.):  
126.9 at the boiling point  
141.68 at 77° F.

Heat of Fusion (gram-calories per g.):  
16.9 at 15° C.

Heat of Combustion (kilogram-calories per mole): 1147.9 (liquid)

Uses: organic syntheses

**Solubility:**

insoluble in water    soluble in alcohol  
very soluble in ether

**Additional Data:**

C.S.T. aniline,  $69.7^{\circ}\text{C}$ .  
critical temperature,  $479^{\circ}\text{F}$ .  
coefficient of expansion,  
0.00068 at  $68^{\circ}\text{F}$ .  
total heating values (at  $77^{\circ}\text{F}$ .)  
Btu. per lb., 20625  
Btu. per cu. ft. (gas) —  
Btu. per gal. (liquid), 118610  
specific gravity of gas (ideal)  
(air = 1.0), 3.4592  
specific gravity of liquid (in vacuo),  
 $0.69324(20/4)^{\circ}\text{C}$ .  $0.69759(60/60)^{\circ}\text{F}$ .  
API gravity at  $60^{\circ}\text{F}$ ., 71.3  
liquid density (in vacuo) at  $60^{\circ}\text{F}$ .,  
5.8160

**2,4-DIMETHYLPENTANE****Synonyms:**

diisopropylmethane  
heptane

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 100.2

Melting Point:  $-123.4$  to  $-119.4^{\circ}\text{C}$ .

Boiling Point:  $80.8^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  
0.6745                      0.675(20/4)

Refractive Index: 1.38153

Specific Heat (Btu. per lb. per  $^{\circ}\text{F}$ .):  
0.527 at  $70.5^{\circ}\text{F}$ . (liquid)

Heat of Vaporization (Btu. per lb.):  
127.5 at the boiling point  
141.1 at  $77^{\circ}\text{F}$ .

Heat of Fusion (gram-calories per g.):  
16.0 at  $15^{\circ}\text{C}$ .

Heat of Combustion (kilogram-calories  
per mole): 1148.9 (liquid)

Uses: organic syntheses

**Solubility:**

insoluble in water    soluble in alcohol  
very soluble in ether

**Additional Data:**

aniline equivalent, 8.0  
C.S.T. aniline,  $78.7^{\circ}\text{C}$ .  
critical temperature,  $476.8^{\circ}\text{F}$ .  
critical pressure, 403 psia.  
coefficient of expansion,  
0.00070 at  $68^{\circ}\text{F}$ .  
total heating values (at  $77^{\circ}\text{F}$ .)  
Btu. per lb., 20623  
Btu. per cu. ft. (gas) —  
Btu. per gal. (liquid), 115040  
specific gravity of gas (ideal)  
(air = 1.0), 3.4592  
specific gravity of liquid (in vacuo),  
 $0.67280(20/4)^{\circ}\text{C}$ .  $0.67754(60/60)^{\circ}\text{F}$ .  
API gravity at  $60^{\circ}\text{F}$ ., 77.4  
liquid density (in vacuo) at  $60^{\circ}\text{F}$ .,  
5.6471

**2,4-DIMETHYL-2-PENTANOL****Synonyms:**

isobutyldimethylcarbinol  
isobutyldimethylmethanol  
heptyl alcohol

Formula:  $(\text{CH}_3)_2\text{COHCH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 116.2

Melting Point:  $< -20^{\circ}\text{C}$ .

Boiling Point:  
129 to  $130^{\circ}\text{C}$ . (at 760 mm.)  
 $132.8$  to  $133.4^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8158

Refractive Index: 1.4172

**Solubility:**

insoluble in water    soluble in alcohol  
                                      soluble in ether

**2,3-DIMETHYL-3-PENTANOL****Synonyms:**

ethylisopropylmethylcarbinol  
ethylisopropylmethylmethanol  
heptyl alcohol

Formula:  $(\text{CH}_3)_2\text{CHCOH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

Formula Weight: 116.2

Melting Point:  $< -70^{\circ}\text{C}$ .

## 2,3-DIMETHYL-3-PENTANOL (Cont.)

Boiling Point: 138 to 140° C. (at 75 mm.)

Specific Gravity: 0.8329 at 21° C.

## Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## 2,4-DIMETHYL-3-PENTANOL

## Synonyms:

diisopropylcarbinol  
diisopropylmethanol  
heptyl alcohol

Formula:  $(\text{CH}_3)_2\text{CHCHOHCH}(\text{CH}_3)_2$ 

Formula Weight: 116.2

Melting Point: &lt; -70° C.

Boiling Point: 140° C. (at 760 mm.)

## Specific Gravity:

0.8288(20/4)

6.9 lbs. per gal.

Refractive Index: 1.4226

Flash Point: 120° F. (closed)

## Uses:

commercial solvent	intermediate
denaturant	organic syntheses

## Solubility:

very slightly soluble in water	
soluble in alcohol	soluble in ether

## 2,4-DIMETHYL-3-PENTANONE

Synonyms: diisopropyl ketone

Formula:  $(\text{CH}_3)_2\text{CHCOCH}(\text{CH}_3)_2$ 

Formula Weight: 114.2

Boiling Point: 123.7° C. (at 760 mm.)

## Specific Gravity:

0.8062(20/4)

6.9 lbs. per gal.

## Uses:

denaturant  
softening agent for nitrocellulose  
plastics

## Solubility:

very slightly soluble in water	
soluble in benzene	
∞ (in alcohol)	∞ (in ether)

## 2,3-DIMETHYL-2-PENTENE

Synonyms: ethyltrimethylethylene

Formula:  $(\text{CH}_3)_2\text{C}:\text{C}(\text{CH}_3)\text{C}_2\text{H}_5$ 

Formula Weight: 98.2

Boiling Point: 95.1° C. (at 760 mm.)

Specific Gravity: 0.719

## Solubility:

insoluble in water	soluble in ether
	soluble in alcohol

## 2,4-DIMETHYL-2-PENTENE

Synonyms: isopropyldimethylethylene

Formula:  $(\text{CH}_3)_2\text{C}:\text{CHCH}(\text{CH}_3)_2$ 

Formula Weight: 98.2

Boiling Point: 82.6° C. (at 760 mm.)

## Specific Gravity:

0.6947(20/4)

0.696(22/4)

Refractive Index: 1.4020

## Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## 3,4-DIMETHYL-2-PENTENE

## Synonyms:

1-isopropyl-1,2-dimethylethylene

Formula:  $\text{CH}_3\text{CH}:\text{C}(\text{CH}_3)\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 98.2

## Boiling Point:

86.2 to 86.4° C. (at 760 mm.)

Specific Gravity: 0.7126(20/4)

Refractive Index: 1.4052

## 4,4-DIMETHYL-2-PENTENE

Formula:  $\text{CH}_3\text{CH}:\text{CHC}(\text{CH}_3)_3$ 

Formula Weight: 98.2

Boiling Point: 76.0° C. (at 760 mm.)

Specific Gravity: 0.6881(20/4)

Refractive Index: 1.3986

### DIMETHYLPHOSPHINE

Formula:  $(\text{CH}_3)_2\text{PH}$

Formula Weight: 121.0

Boiling Point: 25° C. (at 760 mm.)

Specific Gravity: <1

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

### DIMETHYL PHTHALATE

Synonyms:

dimethyl 1, 2-benzenedicarboxylate  
methyl phthalate  
phthalic acid dimethyl ester

Formula:  $\text{C}_6\text{H}_4(\text{COOCH}_3)_2$

Characteristics:

oily  
slightly aromatic odor

Formula Weight: 194.2

Freezing Point: 0.0° C.

Boiling Point:

282° C. (at 760 mm.)  
280° C. (at 734 mm.)  
186 to 194° C. (at 50 mm.)  
123° C. (at 5 mm.)  
280 to 290° C. (at 760 mm.)

Specific Gravity:

1.189(25/25)      1.196(15.6/15.6)  
1.1940(20/20)  
9.9 lbs. per gal. at 20° C.

Refractive Index:

1.5155      1.5168

Viscosity (centipoises): 17.2

Flash Point:

325° F. (open)      295° F. (closed)

Heat of Vaporization:

93.1 gram-calories per g.  
167.6 Btu. per lb.

Heat of Combustion:

5769 gram-calories per g.  
119.7 kilogram-calories per mole

Uses:

coating agents  
lacquers, and molding powders  
plastics      safety glass  
rubber  
insecticide, and insectifuge  
solvent plasticizer for cellulose  
acetate, and nitrocellulose  
solvent for resins used in lacquers

Solubility:

1.5% by weight (of water) at 20° C.  
0.5 grams per 100 ml. (in water)  
immiscible with petroleum oils  
miscible with common organic solvents  
and oils  
0.5% by weight (in mineral oil)  
at 20° C.  
0.34% by weight (of mineral oil)  
at 20° C.

Additional Data:

change in specific gravity per ° C.,  
0.000863  
volatility (mg./sq. cm./hr.),  
>4.0 at 100° C.      171.10 at 190° C.  
coefficient of expansion,  
0.00042 per ° F.      0.00078 at 20° C.  
0.00080 at 55° C.  
heat stability, fair  
light stability, excellent  
fire retardation, none  
vapor density, 6.69  
dilution ratios (nitrocellulose solution  
method),  
with toluene 2.9,  
with petroleum naphtha, immiscible

### $\alpha, \beta$ -DIMETHYLPROPYLAMINE

Synonyms:

3-amino-2-methyl-n-butane  
methylisopropylcarbinylamine  
amylamine

Formula:  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{NH}_2$

Formula Weight: 87.2

Boiling Point: 84 to 87° C. (at 760 mm.)

$\alpha,\beta$ -DIMETHYLPROPYLAMINE (Cont.)

Specific Gravity: 0.7574 at 19°C.

Refractive Index: 1.4096 at 19°C.

Solubility:

very soluble in water  
soluble in alcohol $\beta,\beta$ -DIMETHYLPROPYLAMINE

Synonyms:

1-amino-2,2-dimethylpropane  
tert-butylmethylamine  
amylamineFormula:  $(\text{CH}_3)_2\text{CCH}_2\text{NH}_2$ 

Formula Weight: 87.2

Boiling Point: 82 to 83°C. (at 760 mm.)

## 1,2-DIMETHYLPYRROLE

Formula:  $\text{CH}_3\text{C}(\text{CH}_3)_3\text{NCH}_3$ 

Formula Weight: 95.1

Boiling Point: 65°C. (at 14 mm.)

## 2,3-DIMETHYLPYRROLE

Formula:  $(\text{CH}_3)_2\text{C}_4\text{H}_2\text{NH}$ 

Formula Weight: 95.1

Boiling Point: 165°C. (at 760 mm.)

## 2,4-DIMETHYLPYRROLE

Formula:  $\text{NHC}(\text{CH}_3):\text{CHC}(\text{CH}_3):\text{CH}$ 

Formula Weight: 95.1

Boiling Point:

171°C. (at 760 mm.)

165°C. (at 743 mm.)

Specific Gravity: 0.927(14/4)

Solubility:

slightly soluble in water  
soluble in alcohol, ether, and benzene

## 2,5-DIMETHYLPYRROLE

Formula:  $\text{HNC}(\text{CH}_3):\text{CHCH}:\text{C}(\text{CH}_3)$ 

Characteristics: oily

Formula Weight: 95.1

Boiling Point: 165 to 169°C. (at 760 mm.)

Specific Gravity: 0.935(20/20)

Refractive Index: 1.5036

Solubility:

very slightly soluble in water  
very slightly soluble in alkalis  
very soluble in alcohol  
very soluble in ether

## 2,4-DIMETHYLQUINOLINE

Synonyms: 4-methylquinaldine

Formula:  $(\text{CH}_3)_2\text{C}_9\text{H}_5\text{N}$ 

Formula Weight: 157.2

Boiling Point: 264 to 265°C. (at 760 mm.)

Specific Gravity: 1.061(15/4)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## 5,8-DIMETHYLQUINOLINE

Formula:  $(\text{CH}_3)_2\text{C}_9\text{H}_5\text{N}$ 

Formula Weight: 157.2

Boiling Point: 265°C. (at 736 mm.)

Specific Gravity: 1.070(21/4)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## 6,8-DIMETHYLQUINOLINE

Synonyms:  $\beta$ -citisolidineFormula:  $(\text{CH}_3)_2\text{C}_9\text{H}_5\text{N}$ 

Formula Weight: 157.2

Boiling Point: 268 to 269°C. (at 760 mm.)

Specific Gravity: 1.0665 at 40° C.

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

2, 3-DIMETHYLTHIOPHENE

Synonyms: 2, 3-thioxene

Formula:  $(\text{CH}_3)_2\text{C}_4\text{H}_2\text{S}$

Formula Weight: 112.2

Melting Point: -49° C.

Boiling Point: 136 to 140° C. (at 760 mm.)

Specific Gravity:

0.9938(20/20)      0.999 at 20° C.  
0.994 at 25° C.

Refractive Index:

1.519 at 20° C.      1.517 at 25° C.

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

2, 4-DIMETHYLTHIOPHENE

Synonyms: 2, 4-thioxene

Formula:  $(\text{CH}_3)_2\text{C}_4\text{H}_2\text{S}$

Formula Weight: 112.2

Boiling Point: 137 to 138° C. (at 760 mm.)

Specific Gravity: 0.9956 at 20° C.

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

2, 5-DIMETHYLTHIOPHENE

Synonyms: 2, 5-thioxene

Formula:  $(\text{CH}_3)_2\text{C}_4\text{H}_2\text{S}$

Formula Weight: 112.2

Boiling Point:

136.5 to 137.5° C. (at 760 mm.)

Specific Gravity:

0.9859(19/4)      0.9761 at 17.5° C.

Refractive Index:

1.5142      1.513

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

3, 4-DIMETHYLTHIOPHENE

Synonyms: 3, 4-thioxene

Formula:  $(\text{CH}_3)_2\text{C}_4\text{H}_2\text{S}$

Formula Weight: 112.2

Boiling Point: 144 to 146° C. (at 760 mm.)

Specific Gravity: 1.008(23/22)

N, N-DIMETHYL-o-TOLUIDINE

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{N}(\text{CH}_3)_2$

Formula Weight: 135.2

Melting Point: -60.0° C.

Boiling Point: 184.6° C. (at 760 mm.)

Specific Gravity: 0.9286(20/4)

Refractive Index: 1.5153

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)

N, N-DIMETHYL-m-TOLUIDINE

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{N}(\text{CH}_3)_2$

Characteristics: yellow

Formula Weight: 135.2

Melting Point: -61 to -60° C.

Boiling Point: 212.5° C. (at 760 mm.)

Specific Gravity: 0.941(20/4)

Refractive Index: 1.5492

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)

## N, N-DIMETHYL-p-TOLUIDINE

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{N}(\text{CH}_3)_2$ 

Formula Weight: 135.2

Boiling Point: 210 to 211°C. (at 760 mm.)

Specific Gravity: 0.9287 to 0.937(20/4)

Refractive Index: 1.5366

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## DIMETHYLZINC

Synonyms: zinc dimethyl

Formula:  $(\text{CH}_3)_2\text{Zn}$ 

Formula Weight: 95.5

Melting Point: -40°C.

Boiling Point: 46°C. (at 760 mm.)

Specific Gravity: 1.386 at 11°C.

## Solubility:

decomposes in water  
 decomposes in alcohol

## 1,1-DINITROETHANE

Synonyms: uns-dinitroethaneFormula:  $\text{CH}_3\text{CH}(\text{NO}_2)_2$ 

Formula Weight: 120.1

Boiling Point: 185 to 186°C. (at 760 mm.)

Specific Gravity: 1.3503(23.5/23.5)

## Solubility:

slightly soluble in water  
 soluble in alcohol soluble in ether

## 1,1-DINITROHEXANE

Formula:  $\text{C}_5\text{H}_{11}\text{CH}(\text{NO}_2)_2$ 

## Characteristics:

yellow oily

Formula Weight: 176.2

Boiling Point: decomposes

Specific Gravity: &gt;1

## Solubility:

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether

## DINITROMETHANE

Formula:  $\text{CH}_2(\text{NO}_2)_2$ 

## Characteristics:

yellow oily

Formula Weight: 106.0

Melting Point: &lt; -15°C.

## Boiling Point:

100°C. (at 760 mm.) explodes

## Solubility:

soluble in water, alcohol, and ether

Additional Data: unstable

## 1,1-DINITROPROPANE

Formula:  $\text{C}_2\text{H}_5\text{CH}(\text{NO}_2)_2$ 

## Characteristics: oily

Formula Weight: 134.1

Boiling Point: 189°C. (at 760 mm.)

Specific Gravity: 1.258 at 22°C.

Solubility: soluble in alkalies

Additional Data: acidic

## DIOCTYLAMINE

## Synonyms:

di-2-ethylhexylamine  
 diethylhexylamine

## Formula:

$[\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{C}_2\text{H}_5)\text{CH}_3]_2\text{NH}$

Formula Weight: 241.5

Boiling Point: 281.1°C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.01 at 20°C.

## Specific Gravity:

0.8622(20/20)  
 6.7 lbs. per gal. at 20°C.

Flash Point: 270°F. (open)

## Uses:

partial solvent for cumar, rosin, some phenolic and varnish type alkyds, resins of high acid number organic syntheses of dyes, antioxidants, and emulsifying agents rubber accelerator

## Solubility:

0.17% by weight (of water)  
0.02 grams per 100 ml. (in water)  
 soluble in acetone, benzene, and ethyl acetate

## DIOCTYL PHTHALATE

## Synonyms:

di-2-ethylhexyl phthalate  
 "Flexol" plasticizer DOP  
 octyl phthalate  
 phthalic acid dioctyl ester

Formula:  $C_6H_4[COOCH_2CH(C_2H_5)C_4H_9]_2$

## Characteristics:

light colored                      stable  
 characteristic, moderate odor

Formula Weight: 390.5

Melting Point: gummy at -50° C.

## Boiling Point:

386.9° C. (at 760 mm.)  
229° C. (at 5 mm.)  
215 to 235° C. (at 4 mm.)

## Vapor Pressure (mm. Hg):

<0.01 at 20° C.                      0.07 at 150° C.

## Specific Gravity:

0.9861(20/20)  
8.2 lbs. per gal. at 20° C.

## Refractive Index:

1.4859                                      1.484 at 25° C.

Viscosity (centipoises): 81.4

Flash Point: 425° F. (open)

## Heat of Vaporization:

54.8 gram-calories per g.  
98.7 Btu. per lb.

## Uses:

plasticizer for vinyl-chloride-acetate resins  
 cloth coating  
 wire insulation  
 synthetic rubber  
 weather-proof covers

## Solubility:

0.2% by weight (of water) at 20° C.  
<0.01 by weight (in water) at 20° C.  
 soluble in methyl alcohol  
 soluble in ether  
 $\infty$  (in gasoline)  
 miscible with mineral oil and with common organic solvents

## Additional Data:

light stability in Vinylite resin VYHF, excellent  
 light stability in cellulose nitrate, excellent  
 heat stability, excellent  
 evaporation rate at 105° C. (loss/sq. cm.),  
0.0009 g. after 34 hours  
0.0016 g. after 100 hours  
 volatility (mg./sq. cm./hr.),  
0.02 at 100° C., 15 at 190° C.  
 change in specific gravity per ° C.,  
0.000746  
 coefficient of expansion,  
0.00076 at 20° C.    0.00078 at 55° C.  
 fire point, 460° F.  
 resistivity at 25° C.,  
 $>5 \times 10^5$  megohm-cm.  
 power factor at 60 cycles and 25° C.,  
4.0%  
 moisture permeability (g./sq. cm./cm./hr.)  
 in Vinylite resin VYHF, 0.58  
 in cellulose nitrate, 3.41

m-DIOXANE

## Synonyms:

dihydro-m-dioxin  
 1,3-dioxane  
 trimethylene formal  
 trimethylene glycol methylene ether  
 trimethylene methylene dioxide

## M-DIOXANE (Cont.)

Formula:  $\text{OCH}_2\text{OCH}_2\text{CH}_2\text{CH}_2$ 

Formula Weight: 88.1

Melting Point:  $-42^\circ\text{C}$ .Boiling Point:  
 $105^\circ\text{C}$ . (at 755 mm.)  
 $105$  to  $106^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.0342(20/4)

Refractive Index: 1.4165

Solubility:  
 $\infty$  (in water)                       $\infty$  (in alcohol)  
    $\infty$  (in ether)

## p-DIOXANE

## Synonyms:

diethylene dioxide  
diethylene oxide  
1, 5-dioxane  
glycol ethylene ether  
tetrahydro-p-dioxin  
diethylene ether  
dioxyethylene etherFormula:  $\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2$ Characteristics:  
faint pleasant ethereal odor

Formula Weight: 88.1

Melting Point:  
 $11.7^\circ\text{C}$ .                       $10^\circ\text{C}$ .  
 $9$  to  $13^\circ\text{C}$ .Boiling Point:  
 $101.5^\circ\text{C}$ . (at 760 mm.)  
 $95$  to  $103^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  
 $1.0353(20/4)$                        $1.0356(20/20)$   
 $8.6$  lbs. per gal. at  $20^\circ\text{C}$ .Refractive Index:  
 $1.4232$                        $1.4221$ Surface Tension (dynes per cm.):  
 $36.9$  at  $25^\circ\text{C}$ .Viscosity (poises):  $0.0120$  at  $25^\circ\text{C}$ .Inflammability Range (volume per cent  
in air):  
 $1.97$  (lower limit)       $22.2$  (upper limit)Flash Point:  
 $65^\circ\text{F}$ . (open)                       $65^\circ\text{F}$ . (closed)Specific Heat (gram-calories per g.  
per  $^\circ\text{C}$ .):  $0.420$  (liquid)Heat of Vaporization (gram-calories  
per g.):  
 $98.6$  at the boiling pointHeat of Fusion (gram-calories per g.):  
 $33.8$  at  $15^\circ\text{C}$ .Heat of Combustion (kilogram-calories  
per mole):  $581$  (liquid)

## Uses:

solvent for benzylcellulose, cellulose  
acetate, ethylcellulose, many resins  
of the alcohol and oil soluble types,  
nearly all vegetable and mineral oils,  
fats, and greases  
manufacture of lacquers, plastics,  
varnishes, varnish and paint  
removersSolubility:  
 $\infty$  (of water)                       $\infty$  (in water)  
very soluble in alcohol  
very soluble in ether  
 $\infty$  (in most organic liquids)  
miscible with most organic solvents

## Additional Data:

azeotropic mixture with water boils  
at  $87.8^\circ\text{C}$ ., and contains 81.6%  
dioxane  
vapor density,  $3.03$   
coefficient of expansion,  
 $0.001030$  per  $^\circ\text{C}$ . to  $20^\circ\text{C}$ .,  
 $0.001070$  per  $^\circ\text{C}$ . to  $55^\circ\text{C}$ .  
electrical conductivity,  
 $<2 \times 10^{-8}$  mhos at  $25^\circ\text{C}$ .

## 1, 3-DIOXOLANE

## Synonyms:

dioxalane                      glycol formal  
glycolmethylene ether  
dihydro-1, 3-dioxole

Formula:  $\text{OCH}_2\text{CH}_2\text{OCH}_2$   
Formula Weight: 74.1  
Boiling Point: 75 to 76° C. (at 760 mm.)  
Vapor Pressure (mm. Hg): 70 at 20° C.  
Specific Gravity:  
    1.060(20/4)                      1.065(20/20)  
    8.2 lbs. per gal. at 20° C.  
Flash Point: 35° F. (open)  
Uses:

    low boiling solvent  
    solvent and extractant for cellulose  
    derivatives, dyes, fats, waxes, and  
    oils

Solubility:  
    ∞ (of water)                      ∞ (in water)

DIPENTENE

Synonyms:  
    cajepentine                      limonene (dl)  
    cimene                            kautschin  
    dipentine                        Δ-1, 8-terpodiene  
    inactive limonene

Formula:  $\text{CH}_3(\text{C}_6\text{H}_8)\text{C}:(\text{CH}_2)\text{CH}_3$   
Formula Weight: 136.2

Boiling Point:  
    175 to 176° C. (at 760 mm.)  
    172 to 190° C. (at 760 mm.)  
    172 to 200° C. (at 760 mm.)  
Specific Gravity:  
    0.884 at 20° C.                      0.853 at 20° C.  
    0.847(15/15)                      0.848  
  to 0.825(15/15)  
    7.15 lbs. per gal. at 15.5° C.  
    7.10 lbs. per gal. at 20° C.

Refractive Index: 1.473 at 20° C.  
Flash Point: 109.4° F. (closed)

Uses:  
    solvent for alkyd and cumar resins,  
    ester gum, metallic soap driers,  
    oleoresinous products, and waxes  
    dispersing and wetting agent  
    manufacture of chemicals, polishes,  
    resins, and waxes

Solubility:  
    water is insoluble in this compound  
    insoluble in water  
    soluble in hot alcohol  
    slightly soluble in ether  
Additional Data:  
    coefficient of expansion,  
    0.00086 at 10 to 30° C.  
    commercial product "terpene"  
    boiling point, 180 to 190° C. (90%)  
    specific gravity, 0.865

p-tert-DIPHENYL BUTYL  
PHENYL PHOSPHATE

Synonyms: 1-phosphen  
Formula:  $\text{C}_4\text{H}_9\text{C}_6\text{H}_4\text{OPO}(\text{OC}_6\text{H}_5)_2$   
Formula Weight: 382.4  
Melting Point: <0° C.  
Boiling Point: 245 to 260° C. (at 5 mm.)  
Specific Gravity: 1.16(25/25)  
Solubility:  
    insoluble in water  
    very soluble in alcohol  
    ∞ (in carbon tetrachloride)  
    ∞ (in benzene)

DIPHENYL-o-CHLOROPHENYL  
PHOSPHATE

Formula:  $(\text{C}_6\text{H}_5\text{O})_2\text{POOC}_6\text{H}_4\text{Cl}$   
Formula Weight: 360.7  
Melting Point: <0° C.  
Boiling Point: 225 to 260° C. (at 15 mm.)  
Specific Gravity: 1.30(25/25)  
Solubility:  
    insoluble in water  
    very soluble in alcohol  
    ∞ (in carbon tetrachloride)  
    ∞ (in benzene)

uns-DIPHENYLETHANE

Synonyms:  
    1,1-diphenylethane    dibenzyl  
    bibenzyl                      α-methylditane

uns-DIPHENYLETHANE (Cont.)Formula:  $(C_6H_5)_2CHCH_3$ 

Characteristics: oily

Formula Weight: 182.3

Melting Point:  $-21.5^{\circ}C$ .

Boiling Point:

272 $^{\circ}C$ . (at 760 mm.)268 to 286 $^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.004 at 20 $^{\circ}C$ .      0.9877(25/4)

Refractive Index: 1.5761

Uses:

organic syntheses

solvent for nitrocellulose

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

soluble in carbon disulfide

## DIPHENYLKETENE

Formula:  $(C_6H_5)_2C:CO$ 

Characteristics: red to yellow

Formula Weight: 194.2

Boiling Point: 265 to 270 $^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.104(20/4)

## DIPHENYLMETHANE

Synonyms:

benzylbenzene

ditane

Formula:  $(C_6H_5)_2CH_2$ 

Characteristics: geranium-like odor

Formula Weight: 168.2

Melting Point:

26 to 27 $^{\circ}C$ .      26.5 $^{\circ}C$ .

Boiling Point:

261 to 262 $^{\circ}C$ . (at 760 mm.)264 to 267 $^{\circ}C$ . (at 760 mm.)237.5 $^{\circ}C$ . (at 400 mm.)210.7 $^{\circ}C$ . (at 200 mm.)186.3 $^{\circ}C$ . (at 100 mm.)170.2 $^{\circ}C$ . (at 60 mm.)157.8 $^{\circ}C$ . (at 40 mm.)139.8 $^{\circ}C$ . (at 20 mm.)122.8 $^{\circ}C$ . (at 10 mm.)104 to 107 $^{\circ}C$ . (at 5 mm.)76.0 $^{\circ}C$ . (at 1 mm.)

Specific Gravity:

1.0008(26/4)      1.00(25/20)

Refractive Index:

1.574 at 25 $^{\circ}C$ .      1.5768Flash Point: 266 $^{\circ}F$ . (closed)Heat of Fusion (gram-calories  
per g.): 25.2 at 15 $^{\circ}C$ .

Uses:

dyes

organic syntheses

perfumery

Solubility:

insoluble in water

soluble in alcohol, ether, chloroform,  
acetone, and benzene $\infty$  (in carbon tetrachloride) $\infty$  (in methyl alcohol)Additional Data: vapor density, 5.79DIPHENYL MONO  
(o-XENYL) PHOSPHATEFormula:  $(C_6H_5O)_2PO(OC_6H_4C_6H_5)$ 

Characteristics: mobile liquid

Formula Weight: 402.0

Pour Point: -15 to -4 $^{\circ}C$ .Boiling Point: 250 to 285 $^{\circ}C$ . (at 5 mm.)

Specific Gravity:

1.20(60/4)      1.23(25/25)  
10.3 lbs. per gal. at 25 $^{\circ}C$ .Refractive Index: 1.582 to 1.590 at 60 $^{\circ}C$ .

Surface Tension (dynes per cm.):

41.7 at 60 $^{\circ}C$ .Viscosity (centipoises): 30 to 55 at 60 $^{\circ}C$ .Flash Point: 437 $^{\circ}F$ . (closed)

## Uses:

plasticizer for cellulose ether and  
other cellulose derivatives

## Solubility (grams per 100 g.):

8 (in toluene, petroleum naphtha  
diluent boiling point 95 to 125° C.)  
10 (in V.M.P. naphtha)  
∞ (in toluene) ∞ (in alcohol)  
∞ (in ethylene dichloride)  
∞ (in carbon tetrachloride)  
∞ (in butyl alcohol)  
∞ (in ethyl acetate)  
∞ (in butyl acetate)

## Additional Data:

fire point, 752° F.  
coefficient of expansion, 0.00072  
dielectric constant,  
1000 cycles, 6.5  
1 million cycles, 7.2  
power factor,  
1000 cycles, 2.5%  
1 million cycles, 4.2%  
dielectric strength, volts/mil. 29,000  
volatility, 100 hours at 100° C., 0.3  
resistivity, ohms/cu. m.,  
 $1.5 \times 10^{11}$

## DIPHENYL SELENIUM

## Synonyms:

phenyl selenium      selenium dephenyl

Formula:  $(C_6H_5)_2Se$

Characteristics: oily

Formula Weight: 233.2

Melting Point: 2.5° C.

Boiling Point: 301 to 302° C. (at 760 mm.)

Specific Gravity: 1.338(16/4)

## Solubility:

∞ (in alcohol)      ∞ (in ether)

## DIPHENYLTHIAMETHANE

Formula:  $C_{12}H_{10}S$

Formula Weight: 186.2

Melting Point: -22° C.

## Boiling Point:

295° C. (at 760 mm.)

212° C. (at 100 mm.)

147° C. (at 10 mm.)

## Specific Gravity:

1.115 at 20° C.

1.111 at 25° C.

Refractive Index: 1.633

## DIPHOSGENE

## Synonyms:

perchloromethyl formate  
trichloromethyl chloroformate  
superpalite

Formula:  $ClCOOCCl_3$

Formula Weight: 197.9

Melting Point: -57° C.

Boiling Point: 127.5° C. (at 760 mm.)

Specific Gravity: 1.653(14/4)

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## DIPROPYLAMINE

Synonyms: di-n-propylamine

Formula:  $(CH_3CH_2CH_2)_2NH$

Characteristics: ammonia odor

Formula Weight: 101.2

Solidification Point: -39.6° C.

## Boiling Point:

110.7° C. (at 760 mm.)

105 to 110° C. (at 760 mm.)

## Specific Gravity:

0.7384(20/4)

0.740(20/20)

Refractive Index: 1.4046 at 19.5° C.

Viscosity (centipoises): 0.53 at 25° C.

Flash Point: 45° C. (closed)

## DIPROPYLAMINE (Cont.)

## Solubility:

soluble in water, methyl alcohol,  
acetone, benzene, gasoline, and  
ethyl acetate

very soluble in alcohol  
 $\infty$  (in ether)

## Additional Data:

coefficient of expansion,  
0.00151 per  $^{\circ}\text{C}$ .

n-p-DIPROPYLAMINO BENZALDEHYDE

Formula:  $(\text{C}_3\text{H}_7)_2\text{NC}_6\text{H}_4\text{CHO}$

Characteristics: pale yellow

Formula Weight: 205.3

Boiling Point: 204 to  $206^{\circ}\text{C}$ . (at 20 mm.)

N, N-DIPROPYLANILINE

Formula:  $\text{C}_6\text{H}_5\text{N}(\text{C}_3\text{H}_7)_2$

## Characteristics:

yellow                      oily

Formula Weight: 177.3

## Boiling Point:

245 to  $246^{\circ}\text{C}$ . (at 760 mm.)

238 to  $241^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.9104(20/4)

## Solubility:

soluble in alcohol      insoluble in water  
soluble in ether

DIPROPYL a, a'-DIBROMOSUCCINATE

## Synonyms:

a, a'-dibromosuccinic acid dipropyl  
ester

propyl a, a'-dibromosuccinate

Formula:  $(\text{CHBrCOOC}_3\text{H}_7)_2$

Characteristics: pale yellow

Formula Weight: 360.1

Boiling Point: 147 to  $150^{\circ}\text{C}$ . (at 1 mm.)

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## DIPROPYL DISULFIDE

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{SSCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 150.3

Melting Point:  $-102^{\circ}\text{C}$ .

Boiling Point: 192 to  $193^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.814 at  $17^{\circ}\text{C}$ .

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## DIPROPYLENE GLYCOL

## Synonyms:

$\beta$ ,  $\beta'$ -dihydroxy-di-n-propyl ether  
1, 1'-oxydi-2-propanol  
bis (2-hydroxypropyl) ether

Formula:  $(\text{CH}_3\text{CHOHCH}_2)_2\text{O}$

## Characteristics:

colorless to pale straw colored  
viscous

Formula Weight: 134.2

Pour Point:  $-40^{\circ}\text{F}$ .

## Boiling Point:

$231.8^{\circ}\text{C}$ . (at 760 mm.)

$215$  to  $245^{\circ}\text{C}$ . (at 760 mm.)

$147^{\circ}\text{C}$ . (at 50 mm.)

## Specific Gravity:

1.025(20/20)

1.018 to 1.028(25/25)

8.5 lbs. per gal. at  $20^{\circ}\text{C}$ .

Refractive Index: 1.439 at  $77^{\circ}\text{F}$ .

Surface Tension (dynes per cm.):

32 at  $77^{\circ}\text{F}$ .

## Viscosity (centipoises):

700 at  $32^{\circ}\text{F}$ .

4 at  $150^{\circ}\text{F}$ .

48 at  $77^{\circ}\text{F}$ .

Flash Point:  $280^{\circ}\text{F}$ . (open)

Specific Heat (cals./g./ $^{\circ}\text{C}$ .):

0.55 at  $77^{\circ}\text{F}$ .

Uses:  
solvent for nitrocellulose and shellac  
chemical intermediate  
humectant  
lacquers plasticizer  
coatings  
partial solvent for low and high  
viscosity cellulose acetate and for  
kauri gum  
mutual solvent for normally immiscible  
liquids

Solubility:  
 $\infty$  (of water)                      soluble in toluene  
 $\infty$  (in water)

Additional Data:  
fire point, 253.4° F.

		Specific Heat of Aqueous Dipropylene Glycol Solutions						
		Dipropylene Glycol % by Weight						
Temp. °C.		100	80	60	40	20	10	5
10	.562	.688	.762	.840	.889	.915	.915	
20	.568	.696	.769	.845	.892	.917	.917	
30	.578	.705	.774	.850	.895	.920	.920	
40	.588	.712	.778	.853	.899	.920	.920	
50	.599	.720	.785	.858	.902	.920	.920	
60	.610	.729	.790	.864	.902	.921	.921	
70	.621	.735	.795	.867	.904	.922	.922	
80	.631	.741	.798	.870	.905	.923	.923	
90	.641	.746	.802	.872	.907	.924	.924	

DIPROPYLMERCURY

Synonyms:  
mercury di-n-propyl  
mercury dipropyl  
Formula:  $(CH_3CH_2CH_2)_2Hg$   
Formula Weight: 286.8  
Boiling Point: 189 to 191° C. (at 760 mm.)  
Specific Gravity: 2.124 at 16° C.  
Solubility:  
insoluble in water  
slightly soluble in alcohol  
very soluble in ether

DIPROPYL PHTHALATE

Synonyms:  
phthalic acid dipropyl ester  
propyl phthalate  
Formula:  $C_6H_4(COOCH_2CH_2CH_3)_2$   
Formula Weight: 250.3  
Boiling Point: 129 to 132° C. (at 1 mm.)  
Solubility:  
insoluble in water                      soluble in alcohol  
soluble in ether

DIPROPYLZINC

Synonyms:  
zinc di-n-propyl                      zinc dipropyl  
Formula:  $(CH_3CH_2CH_2)_2Zn$   
Formula Weight: 151.6  
Boiling Point: 158 to 160° C. (at 760 mm.)  
Solubility:  
decomposes in water  
decomposes in alcohol

DITHIOLACETIC ACID

Synonyms: dithioacetic acid  
Formula:  $CH_3CSSH$   
Characteristics:  
red to yellow                      oily  
Formula Weight: 92.2  
Boiling Point: 37° C. (at 15 mm.)  
Specific Gravity: 1.24 at 20° C.  
Solubility:  
insoluble in cold water  
very soluble in alcohol  
very soluble in ether  
soluble in benzene

DI-( $\alpha$ -XENYL)  
MONOPHENYL PHOSPHATE

Formula:  $(C_6H_5C_6H_4)_2PO(OC_6H_5)$   
Characteristics: viscous  
Formula Weight: 476.0

DI-( $\alpha$ -XENYL) MONOPHENYL  
PHOSPHATE (Cont.)Pour Point: 13 to 18° C.Boiling Point: 285 to 330° C. (at 5 mm.)

Specific Gravity:

<u>1.20(60/4)</u>	<u>1.23(25/25)</u>
<u>10.3 lbs. per gal. at 25° C.</u>	

Refractive Index: 1.603 to 1.605 at 60° C.

Surface Tension (dynes per cm.):

42.4 at 60° C.

Viscosity (centipoises):

170 to 200 at 60° C.Flash Point: 482° F. (closed)

Uses:

plasticizer for cellulose ethers and  
other cellulose derivatives

Solubility (grams per 100 g.):

2 (in methyl alcohol) at 25° C.

5 (in V.M.P. naphtha) at 25° C.

 $\infty$  (in toluene)  $\infty$  (in butyl $\infty$  (in carbon alcohol)tetrachloride)  $\infty$  (in ethyl $\infty$  (in ethylene acetate)dichloride)  $\infty$  (in butyl $\infty$  (in alcohol) acetate)

Additional Data:

fire point, 752° F.coefficient of expansion, 0.000715

dielectric constant,

1000 cycles, 5.91 million cycles, 6.0

power factor,

1000 cycles, 0.5%1 million cycles, 3.0%dielectric strength, volts/mil., 28000volatility, 100 hours at 100° C., 0.2resistivity ohms/cu. cm., 1.2 x 10<sup>11</sup>

## DOCOSAMETHYLDECASILOXANE

Formula:  $[(CH_3)_3Si(OSi(CH_3)_2)_4]_2O$ 

Formula Weight: 755.35

Boiling Point: 183° C. (at 4.1 mm.)

Specific Gravity: 0.925

Refractive Index: 1.3988

Uses:

lubricating oils of wide temperature  
rangefoam suppressant for petroleum-type  
lubricating oils

Solubility:

slightly soluble in alcohol and higher  
hydrocarbonssoluble in benzene and lower hydro-  
carbons

## DODECAMETHYLPENTASILOXANE

Formula:  $(CH_3)_3Si[OSi(CH_3)_2]_3OSi(CH_3)_3$ 

Formula Weight: 384.7

Freezing Point: ca. -80° C.

Boiling Point: 229° C. (at 710 mm.)

Specific Gravity: 0.8755

Refractive Index: 1.3925

Uses:

See DECAMETHYLTETRASILOXANE

Solubility:

See DECAMETHYLTETRASILOXANE

## DODECANE

Synonyms:

bihexyl

n-dodecane

dihexyl

Formula:  $CH_3(CH_2)_{10}CH_3$ 

Formula Weight: 170.3

Melting Point:

-9.6° C.

-12° C.

Boiling Point:

214.5° C. (at 760 mm.)

145° C. (at 100 mm.)

Specific Gravity:

0.7511(20/4)

0.766(0/4)

Refractive Index: 1.4216

Viscosity (centipoises): 1.26 at 23.3° C.

Inflammability Range (volume per cent  
in air): 0.6 (lower limit)

Flash Point: 165° F. (closed)

Specific Heat (Btu. per lb. per °F.):  
0.521 at 77° F. (liquid)

Heat of Vaporization (Btu. per lb.):  
115.3 at the boiling point  
154 at 77° F.

Heat of Fusion (gram-calories per g.):  
51.3 at 15° C.

Uses: organic syntheses

Solubility:  
insoluble in water  
very soluble in alcohol  
very soluble in ether

Additional Data:  
specific gravity of gas (ideal)  
(air = 1.0), 5.8803  
specific gravity of liquid (in vacuo),  
0.74874(20/4)° C. 0.7527(60/60)° F.  
API gravity, 56.5 at 60° F.  
liquid density (in vacuo), 6.275 at 60° F.  
aniline point, 182.7  
critical temperature, 385° C.  
critical pressure, 17.5 atm.  
coefficient of expansion,  
0.00053 at 32 to 104° F.  
total heating values (at 77° F.),  
20410 Btu./lb.,  
126920 Btu./cu. ft. - gas,  
Btu./gal. - liquid  
vapor density, 5.86

### 1-DODECANETHIOL

Synonyms:  
n-dodecyl mercaptan  
lauryl mercaptan

Formula:  $\text{CH}_3(\text{CH}_2)_{11}\text{SH}$

Formula Weight: 202.4

Melting Point: -7.5° C.

Boiling Point:  
143° C. (at 15 mm.)  
153 to 155° C. (at 24 mm.)

Specific Gravity: 0.8408(25/4)

Refractive Index: 1.4589

Solubility:  
insoluble in water      soluble in alcohol  
                                      soluble in ether

Additional Data for Commercial Product:  
formula,  $\text{C}_{12.6}\text{H}_{26.2}\text{SH}$  (average)  
characteristics, colorless to slight  
pale yellow, mobile, mild mercaptan  
odor  
formula weight, 210.5  
freezing point, -100° C.  
boiling point, 115 to 177° C. (at 5 mm.)  
specific gravity, 0.849(15.5/15.5)  
flash point, 262° F. (open)  
uses, polymerization modifier in man-  
ufacture of synthetic rubber  
additional data, mercaptan sulfur  
content, 14.4%  
fire point, 282° F.

### 1-DODECENE

Synonyms:  $\alpha$ -dodecylene

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{CH}:\text{CH}_2$

Formula Weight: 168.3

Melting Point:  
-31.5° C.                      -33.6° C.

Boiling Point:  
208.0° C. (at 760 mm.)  
213 to 215° C. (at 760 mm.)  
96° C. (at 15 mm.)

Specific Gravity:  
0.7732(0/4)                      0.7600(25/4)  
0.762(15/4)

Refractive Index: 1.4327

Solubility:  
insoluble in water  
very soluble in alcohol  
very soluble in ether

### 1-DODECENE (commercial grade)

Formula:  
olefin content                      95%  
total dodecenes                      87%  
lighter                                      7%  
heavier                                      6%  
oxidation stabilizer                      trace

Freezing Point: < -60° C.

Boiling Point: 159 to 208° C. (at 760 mm.)

## 1-DODECENE (commercial grade) (Cont.)

Specific Gravity:

47.6° API                      0.790(60/60)° F.  
6.6 lbs. per gal.

Refractive Index: 1.4450Flash Point: 108° F. (closed)

Uses:

organic syntheses      special solvent

## 1-DODECENE (research grade)

Formula:

total isooctenes                      98%  
 olefin content                        99%  
 oxidation stabilizer                0.01%  
 a mixture of various isomers  
 approximating pentamethylheptene

Melting Point: < -57° C.Boiling Point: 181 to 193° C. (at 760 mm.)

Specific Gravity:

49.7° API                      0.781(60/60)° F.

Refractive Index: 1.4397Flash Point: 130° F. (closed)

Uses: organic syntheses

## DODECYL ACETATE

Synonyms:

acetic acid dodecyl ester  
 lauryl acetate

Formula:  $\text{CH}_3\text{COOC}_{12}\text{H}_{25}$ 

Formula Weight: 228.4

Boiling Point: 151 to 152° C. (at 15 mm.)

Uses: perfumes

tert-DODECYL MERCAPTANFormula:  $\text{C}_{12}\text{H}_{25}\text{SH}$ 

Characteristics: mercaptan odor

Formula Weight: 202.4

Freezing Point: < -70° C.Boiling Point: 220 to 233° C. (at 760 mm.)Specific Gravity: 0.860(20/20)Refractive Index: 1.468Viscosity (centipoises): 4.16 at 20° C.Flash Point: 205° F. (open)

Solubility:

water is insoluble in this compound  
 insoluble in water  
 soluble in methyl alcohol, ether,  
 acetone, benzene, gasoline, and  
 ethyl acetate

## 2-DODECYNE

Synonyms:

decylmethylacetylene  
 2-dodecine

Formula:  $\text{CH}_3\text{C}:\text{C}(\text{CH}_2)_8\text{CH}_3$ 

Formula Weight: 166.3

Melting Point: -9° C.

Boiling Point: 105° C. (at 15 mm.)

Specific Gravity: 0.792(15/4)

Solubility: soluble in alcohol

## 6-DODECYNE

Synonyms:

di-n-amylacetylene  
 6-dodecine

Formula:  $\text{C}_5\text{H}_{11}\text{C}:\text{CC}_5\text{H}_{11}$ 

Formula Weight: 166.3

Boiling Point:

100° C. (at 14 mm.)  
 115° C. (at 30 mm.)

Specific Gravity: 0.7816 at 25° C.

Refractive Index: 1.4374 at 25° C.

Solubility:

insoluble in water      soluble in alcohol  
                                      soluble in ether

## E

## ENANTHALDEHYDE

## Synonyms:

enanthal	heptanoic aldehyde
enanthole	heptyl aldehyde
heptaldehyde	heptoic aldehyde
heptanal	oenanthole

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CHO}$

## Characteristics:

burning, sharp and soapy taste  
 almond flavor      oily  
 highly refractive  
 disagreeable penetrating aromatic odor  
 which on dilution has a heavy, fruity  
 and almond-like odor

Formula Weight: 114.2

Melting Point:  $-45$  to  $-42^\circ\text{C}$ .

Boiling Point:  $153$  to  $155^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.850(20/4)

Refractive Index: 1.4131

## Uses:

almond flavors      heptyl alcohol  
 organic syntheses

## Solubility:

slightly soluble in water  
 soluble in alcohol  
 $\infty$  (in ether)  
 one volume dissolves in 12 volumes of  
 50% alcohol

## ENANTHIC ACID

## Synonyms:

enanthylic acid	n-heptylic acid
heptanoic acid	oenanthic acid
n-heptoic acid	oenanthylic acid

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{COOH}$

## Characteristics:

unpleasant odor      oily

Formula Weight: 130.2

Melting Point:  $-10^\circ\text{C}$ .

## Boiling Point:

$221$  to  $223.5^\circ\text{C}$ . (at 760 mm.)  
 $108$  to  $110^\circ\text{C}$ . (at 9 mm.)

## Specific Gravity:

0.9127(20/4)      0.918 at  $20^\circ\text{C}$ .

Refractive Index: 1.4216 at  $19.8^\circ\text{C}$ .

Viscosity (centipoises): 4.356 at  $20^\circ\text{C}$ .

Heat of Combustion (kilogram-calories  
 per mole): 986.1 (liquid)

Uses: organic syntheses

## Solubility (grams per 100 ml.):

0.241 (in water) at  $15^\circ\text{C}$ .  
 soluble in alcohol      soluble in ether

## ENANTHIC ANHYDRIDE

## Synonyms:

heptanoic anhydride  
 heptylic anhydride

Formula:  $[\text{CH}_3(\text{CH}_2)_5\text{CO}]_2\text{O}$

Formula Weight: 242.4

Melting Point:  $17^\circ\text{C}$ .

## Boiling Point:

$258$  to  $268^\circ\text{C}$ . (at 760 mm.)  
 $170$  to  $173^\circ\text{C}$ . (at 15 mm.)

Specific Gravity: 0.932(20/4)

Refractive Index: 1.4312

## Solubility:

insoluble in water      soluble in alcohol  
 soluble in ether

## ENANTHONITRILE

## Synonyms:

heptanenitrile      oenanthylic nitrile  
 n-hexyl cyanide

## ENANTHONITRILE (Cont.)

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CN}$ 

Formula Weight: 111.2

Melting Point:  $-65^\circ\text{C}$ .

Boiling Point:

186.1 $^\circ\text{C}$ . (at 760 mm.)74.7 $^\circ\text{C}$ . (at 16 mm.)183 to 184 $^\circ\text{C}$ . (at 765 mm.)

Specific Gravity:

0.8018(30/4)

0.811(20/0)

Refractive Index: 1.4104 at 30 $^\circ\text{C}$ .

Solubility:

very slightly soluble in water

 $\infty$  (in ether)  $\infty$  (in acetic acid) $\infty$  (in chloroform)  $\infty$  (in acetone) $\infty$  (in absolute alcohol) $\infty$  (in carbon tetrachloride) $\infty$  (in methyl alcohol)

## EPICHLOROHYDRIN

Synonyms:

1-chloro-2,3-epoxypropane

(chloromethyl) oxirane

2-chloropropylene oxide

 $\alpha$ -epichlorohydrin

glycerol epichlorohydrin

Formula:  $\text{OCH}_2\text{CHCH}_2\text{Cl}$ 

Characteristics:

toxic

very volatile

chloroform-like odor

Formula Weight: 92.5

Melting Point:  $-25.6^\circ\text{C}$ .Boiling Point: 116 to 117 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.203(0/4)

1.1801(20/4)

1.179(20/20)

1.183(25/25)

9.85 lbs. per gal. at 20 $^\circ\text{C}$ .Refractive Index: 1.4420 at 11.55 $^\circ\text{C}$ .Flash Point: 90 $^\circ\text{F}$ . (open)Heat of Vaporization (gram-calories  
per g.): 95.1

Uses:

organic syntheses	gums and resins
paints	coatings
lacquers	varnishes
solvent for cellulose esters and ethers	

Solubility (grams per 100 ml.):

1.6 (of water) at 20 $^\circ\text{C}$ .6.6 (in water) at 20 $^\circ\text{C}$ . $\infty$  (in alcohol) $\infty$  (in ether)

insoluble in water

insoluble in petroleum hydrocarbons

miscible with most organic solvents

Additional Data:

unstable

coefficient of expansion,

0.000577 per  $^\circ\text{F}$ .azeotrope with water boils at 87.5 $^\circ\text{C}$ .

and contains 23.4% water

## EPIIDOHYDRIN

Synonyms:

 $\alpha$ -epiiodohydrin

1.2-epoxy-3-iodopropane

(iodomethyl) oxirane

 $\gamma$ -iodopropylene oxideFormula:  $\text{OCH}_2\text{CHCH}_2\text{I}$ 

Formula Weight: 184.0

Boiling Point: 160 to 180 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 2.03(13/4)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## 3,4-EPOXY-1-BUTENE

Synonyms:

butadiene monoxide

vinylethylene oxide

Formula:  $\text{OCH}_2\text{CHCH}:\text{CH}_2$ 

Characteristics: sharp, gasoline-like odor

Formula Weight: 70.1

Melting Point:  $<-85^\circ\text{C}$ .Boiling Point: 66 $^\circ\text{C}$ . (at 760 mm.)



## 1,2-EPOXYPROPENE

## Synonyms:

allylene oxide      methyloxirene

Formula:  $\text{CH}_3\text{C}:\text{CHO}$ 

Formula Weight: 56.1

Boiling Point: 62 to 63° C. (at 760 mm.)

## Solubility:

slightly soluble in water

 $\infty$  (in alcohol)       $\infty$  (in ether)insoluble in aqueous potassium  
carbonate

Additional Data: volatile with steam

## ESTRAGOLE

## Synonyms:

p-allylanisole

chavicol methyl ether

estragol

p-methoxyallyl phenolFormula:  $\text{CH}_2:\text{CHCH}_2\text{C}_6\text{H}_4\text{OCH}_3$ 

Formula Weight: 148.2

Boiling Point: 215° C. (at 760 mm.)

Specific Gravity: 0.9645(21/4)

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## 1,1-ETHANEDIOL DIACETATE

## Synonyms:

1,1-diacetoxyethane

ethylidene diacetate

Formula:  $\text{CH}_3\text{CH}(\text{OCOCH}_3)_2$ 

Formula Weight: 146.1

Boiling Point: 168° C. (at 740 mm.)

Specific Gravity: 1.061 at 12° C.

## 1,2-ETHANEDIOL DIACETATE

## Synonyms:

ethylene glycol diacetate

glycol diacetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OOCCH}_3$ 

## Characteristics:

faint odor resembling ethyl acetate

Formula Weight: 146.1

Melting Point: -31° C.

## Boiling Point:

190.5° C. (at 760 mm.)

186 to 190° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.38 at 20° C.

## Specific Gravity:

1.109(14/4)      1.1063(20/20)9.2 lbs. per gal. at 20° C.Flash Point: 22.0° F. (open)

## Uses:

solvent for camphor, and cellulose  
derivativessolvent mixtures for cellulose  
derivatives and resins

perfume fixative

lacquers, cellulose ester printing inks

plasticizer for benzyl- and ethyl-  
cellulose

## Solubility:

7.0% by weight (of water)14.3 grams per 100 ml. (in water)  
at 22° C.16.4% (in water) at 20° C. $\infty$  (in alcohol)       $\infty$  (in ether)  
soluble in benzene

## Additional Data:

xylene dilution ratio, 1.4

## 1,2-ETHANEDIOL DIBUTYRATE

## Synonyms:

ethylene butyrate

ethylene glycol dibutyrate

glycol dibutyrate

Formula:  $(\text{CH}_2\text{OOCCH}_2\text{CH}_2\text{CH}_3)_2$ 

Formula Weight: 202.3

Boiling Point: 240° C. (at 760 mm.)

Specific Gravity: 1.024(0/4)

**Solubility:**

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

**1,2-ETHANEDIOL DICAPRYLATE****Synonyms:**

ethylene caprylate  
 ethylene glycol dicaprylate  
 glycol dicaprylate

Formula:  $(\text{CH}_2\text{OOC}\text{C}_{17}\text{H}_{15})_2$

Characteristics: pale yellow

Formula Weight: 314.5

Melting Point:  $22^\circ\text{C}$ .

Solubility: insoluble in water

**1,2-ETHANEDIOL DIFORMATE****Synonyms:**

ethylene formate  
 ethylene glycol diformate  
 glycol diformate

Formula:  $\text{HCOOCH}_2\text{CH}_2\text{OOCH}$

Characteristics: mild odor

Formula Weight: 118.1

Boiling Point:

$174^\circ\text{C}$ . (at 760 mm.)  
 $177.1^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure (mm. Hg): 0.5 at  $20^\circ\text{C}$ .

Specific Gravity:

1.2277(20/20)  
10.2 lbs. per gal. at  $20^\circ\text{C}$ .

Flash Point: 2000 F. (open)

**Uses:**

solvent for cellulose acetate, cellulose  
 ethers, and nitrocellulose

**Solubility:**

this compound decomposes if water is  
 added to it  
 decomposes in water  
 soluble in alcohol    soluble in ether

**1,2-ETHANEDIOL MONOACETATE****Synonyms:**

ethylene glycol monoacetate  
 glycol monoacetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OH}$

Formula Weight: 104.1

Boiling Point:  $181$  to  $182^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

$1.109$  at  $20^\circ\text{C}$ .             $1.108$  at  $15^\circ\text{C}$ .

**Uses:**

solvent for cellulose esters and ethers,  
 nitrocellulose, and resins

**Solubility:**

$\infty$  (in water)             $\infty$  (in ether)  
 $\infty$  (in alcohol)  
 soluble in benzene    soluble in toluene  
 miscible with many lacquer solvents

**1,2-ETHANEDIOL MONOFORMATE****Synonyms:**

ethylene glycol monoformate  
 glycol monoformate  
 $\beta$ -hydroxyethyl formate

Formula:  $\text{HCOOCH}_2\text{CH}_2\text{OH}$

Formula Weight: 90.1

Boiling Point:

$180^\circ\text{C}$ . (at 760 mm.)  
 $88^\circ\text{C}$ . (at 25 mm.)

Specific Gravity:  $1.199(15/4)$

**Solubility:**

$\infty$  (in water)             $\infty$  (in ether)  
 $\infty$  (in alcohol)

**1,2-ETHANEDITHIOL****Synonyms:**

dithioglycol  
 ethylene dimercaptan  
 ethylene mercaptan

Formula:  $\text{CH}_2\text{SHCH}_2\text{SH}$

Formula Weight: 94.2

Boiling Point:  $146^\circ\text{C}$ . (at 760 mm.)

## 1,2-ETHANEDITHIOL (Cont.)

Specific Gravity: 1.123 at 23.5° C.

## Solubility:

soluble in alcohol  
 very soluble in alkali  
 soluble in ammonium hydroxide

## ETHANESULFONYL CHLORIDE

## Synonyms:

ethylsulfonyl chloride  
 ethylsulfone chloride

Formula:  $C_2H_5SO_2Cl$ 

Formula Weight: 128.6

Boiling Point: 177.5° C. (at 760 mm.)

Specific Gravity: 1.357(20/4)

## Solubility:

decomposes in water  
 decomposes in alcohol  
 very soluble in ether

## ETHANETHIOL

## Synonyms:

ethyl hydrosulfide    ethyl thioalcohol  
 ethyl mercaptan    thioethyl alcohol

Formula:  $C_2H_5SH$ 

Characteristics: penetrating odor

Formula Weight: 62.1

## Melting Point:

-147.3° C.                      -121° C.

## Boiling Point:

36° C. (at 760 mm.)  
 34.7 to 37° C. (at 760 mm.)  
 35° C. (at 760 mm.)

## Specific Gravity:

0.840                      0.838 at 20° C.  
 0.839(20/4)              0.832 at 25° C.

## Refractive Index:

1.4306                      1.427 at 25° C.

Inflammability Range (volume per cent in air):

2.8 (lower limit)              18.2 (upper limit)

Solubility (grams per 100 ml.):

1.5 (in water)              soluble in alcohol  
    soluble in alkali

## Additional Data:

autoignition temperature, 570° F.  
 vapor density, 2.11  
 should be stored cool in tightly closed containers  
 critical pressure, 54.2 atm.  
 critical temperature, 225.5° C.

## ETHENYLAMINOPHENOL

Synonyms: 2-methyl benzoxazole

Formula:  $C_6H_4N:C(CH_3)O$ 

Formula Weight: 133.1

Boiling Point: 200 to 201° C. (at 760 mm.)

Specific Gravity: 1.137 at 0° C.

## Solubility:

insoluble in water    ∞ (in ether)  
 soluble in alcohol

## ETHENYLAMINOTHIOPHENOL

Synonyms: 2-methyl benzothiazole

Formula:  $C_6H_4N:C(CH_3)S$ 

Formula Weight: 149.2

Melting Point: 12 to 14° C.

Boiling Point: 238° C. (at 760 mm.)

## Solubility:

insoluble in water  
 soluble in alcohol  
 soluble in hydrochloric acid

## ETHOXYACETIC ACID

## Synonyms:

ethoxyethanoic acid  
 ethyloglycolic acid  
 glycolic ethyl ether

Formula:  $C_2H_5OCH_2COOH$ 

Formula Weight: 104.1

## Boiling Point:

206 to 207° C. (at 760 mm.)  
 slight decomposition

Specific Gravity: 1.102(20/4)

Solubility:

very soluble in water, alcohol, and ether

o-ETHOXYBENZALDEHYDE

Formula:  $C_2H_5OC_6H_4CHO$

Formula Weight: 150.2

Melting Point: 20 to 22° C.

Boiling Point: 247 to 249° C. (at 760 mm.)

Solubility:

∞ (in alcohol) ∞ (in ether)

o-ETHOXYBENZOIC ACID

Synonyms: salicylic acid ethyl ether

Formula:  $C_2H_5OC_6H_4COOH$

Characteristics: oily

Formula Weight: 166.2

Melting Point: 19 to 22° C.

Boiling Point:

decomposes at 300±° C. (at 760 mm.)

Solubility:

very slightly soluble in cold water  
soluble in hot water

p-ETHOXYDIPHENYL SULFIDE

Formula:  $C_2H_5OC_6H_4SC_6H_5$

Formula Weight: 230.3

Boiling Point: 186 to 189° C. (at 10 mm.)

$\beta$ -ETHOXYETHYL ADIPATE

Formula:  $(CH_2)_4(COOCH_2CH_2OC_2H_5)_2$

Formula Weight: 290.4

Boiling Point: 164 to 166° C. (at 4 mm.)

$\beta$ -ETHOXYETHYL CHLOROFORMATE

Synonyms:

$\beta$ -ethoxyethyl chlorocarbonate

Formula:  $ClCOOCH_2CH_2OC_2H_5$

Characteristics: pale yellow

Formula Weight: 152.6

Boiling Point: 55 to 65° C. (at 15 mm.)

$\beta$ -ETHOXYETHYL GLYCOLATE

Formula:  $HOCH_2COO(CH_2)_2OC_2H_5$

Formula Weight: 148.2

Boiling Point: 98 to 100° C. (at 7 mm.)

ETHOXYETHYL  
 $\alpha$ -HYDROXYISOBUTYRATE

Formula:

$(CH_3)_2COHCOOCH_2CH_2OC_2H_5$

Formula Weight: 176.2

Boiling Point: 204 to 206° C. (at 760 mm.)

$\beta$ -ETHOXYETHYL LACTATE

Formula:  $CH_3CHOHCOOCH_2CH_2OC_2H_5$

Formula Weight: 162.2

Boiling Point: 99 to 101° C. (at 10 mm.)

ETHOXYETHYL MORPHOLINE

Formula:

$C_2H_5OCH_2CH_2NCH_2CH_2OCH_2CH_2$

Formula Weight: 159.2

Boiling Point: 206.2° C. (at 760 mm.)

Vapor Pressure (mm. Hg): <0.3

Specific Gravity:

0.9648(20/20)

8.0 lbs. per gal. at 20° C.

Solubility: ∞ (in water)

o-ETHOXYPHENOL

Synonyms:

catechol monoethyl ether

guaethol

pyrocatechol monoethyl ether

Formula:  $C_2H_5OC_6H_4OH$

Characteristics: oily

O-ETHOXYPHENOL (Cont.)

Formula Weight: 138.2

Melting Point: 28 to 29° C.

Boiling Point: 216 to 217° C. (at 760 mm.)

## Solubility:

slightly soluble in water

∞ (in alcohol)      ∞ (in ether)

m-ETHOXYPHENOL

## Synonyms:

resorcinol ethyl ether

resorcinol monoethyl ether

Formula:  $C_2H_5OC_6H_4OH$ 

Characteristics: pale yellow

Formula Weight: 138.2

Boiling Point: 246 to 247° C. (at 760 mm.)

## Solubility:

very slightly soluble in water

soluble in alcohol, ether, and benzene

## ETHYL ABIETATE

Synonyms: abietic acid ethyl ester

Formula:  $C_{19}H_{29}COOC_2H_5$ 

## Characteristics:

viscousamber colored

Formula Weight: 330.5

Melting Point: 45° C.

## Boiling Point:

200° C. (at 4 mm.)

350° C. (at 760 mm.)

Specific Gravity: 1.020(20/20)

Refractive Index: 1.4980Flash Point: 352° F. (closed)

Uses: nitrocellulose plasticizer

## Solubility:

insoluble in water    soluble in ether

soluble in most varnish solvents

Additional Data: hardens on oxidation

## ETHYLACETAMIDE

## Synonyms:

acetoethylamide

N-ethylacetamideN-monoethyl acetamideFormula:  $CH_3CONHC_2H_5$ Characteristics: faint odor

Formula Weight: 87.1

Melting Point: -32° C.

## Boiling Point:

205° C. (at 760 mm.)

206 to 208.5° C. (at 760 mm.)

## Specific Gravity:

0.942(4.5/4)

0.923(20/20)Refractive Index: 1.434Viscosity (centipoises): 6.16 at 25° C.Flash Point: 230° F. (closed)

## Solubility:

∞ (in water)

∞ (in alcohol)

insoluble in aqueous alkali

soluble in acids

## Additional Data:

coefficient of expansion,

0.00103 per ° C.

## ETHYL ACETATE

## Synonyms:

acetic acid ethyl ester

acetic ester

ethyl ethanoate

acetic ether

vinegar naphtha

aether aceticus

Formula:  $CH_3COOC_2H_5$ 

## Characteristics:

volatile

agreeable, mild, fruity odor

pleasant somewhat bitter-sweet taste

when diluted

characteristics acid flavor

Formula Weight: 88.1

Melting Point: -83.6 to -82.4° C.

Boiling Point:

77.0 to 77.2° C. (at 760 mm.)  
77.1° C. (at 760 mm.)  
70 to 80° C. (at 760 mm.)

Specific Gravity:

0.901(20/4)                      0.898(25/25)  
0.9066(15/4)                    0.9018(20/20)

Specific Gravity 20/20° C.

85 to 88%, 0.882 to 0.886  
95 to 98%, 0.895 to 0.899  
99%, 0.899 to 0.902

lbs. per gal. at 20° C.

85 to 88%, 7.36  
95 to 98%, 7.47  
99%, 7.50

Refractive Index:

1.370 at 25° C.                      1.3727 at 20° C.  
1.3722 at 18.0° C.

Surface Tension (dynes per cm.):

26.5 at 0° C.                      17.4 at 75° C.  
23.9 at 20° C.

Viscosity (centipoises):

0.582 at 0° C.                      0.407 at 30° C.  
0.512 at 10° C.                      0.367 at 40° C.  
0.455 at 20° C.                      0.333 at 50° C.  
0.279 at 70° C.

10% 1/2 sec. R.S. nitrocellulose solution,

85 to 88%, 32                      99%, 33  
95 to 98%, 33

Inflammability Range (volume per cent in air):

2.18 (lower limit)                      11.5 (upper limit)

Flash Point:

30° F. (open)                      24° F. (closed)

Heat of Vaporization (gram-calories per g.): 102.9 at 15° C.

Heat of Combustion (kilogram-calories per mole): 536.9 (liquid)

Uses:

solvent for airplane dopes, camphor, cellulose acetate, fats, gums, lacquers, nitrocellulose, plastics, pyroxylin, resins, varnishes  
manufacture of artificial horse hair for brushes, fruit flavors, leather and silk, coated papers, dopes, drugs,

dyes, explosives, intermediates, chemicals, lacquer inks, nitrocellulose dopes, paints and varnishes, perfumes, photographic films, polishes, phosgene, pyroxylin cements and plastics, smokeless powder  
textile cleaning  
ethyl alcohol denaturant

Solubility (grams per 100 ml.):

3.3 (of water)  
8.5 at 15° C., 8.6 at 20° C.,  
7.4 at 25° C. (in water)  
∞ (in alcohol)                      ∞ (in oils)  
∞ (in ether)                      ∞ (in acetone)  
∞ (in chloroform)  
miscible with all common organic solvents

Additional Data:

inflammable  
moisture hydrolyzes it slowly to give free acid  
coefficient of expansion,  
0.000750 per ° C.  
azeotrope with water boils at 70.4° C., contains 93.0% ethyl acetate by weight  
autoignition temperature, 907° F.  
vapor density, 3.04  
critical temperature, 250.1° C.  
critical pressure, 37.8 atm.  
absolute viscosity, 4.546 millipoises at 20° C.  
weight of pure vapor, 3930 mg./l.  
should be stored in a cool place, in tightly closed containers, and away from fires

Blush Resistance at 90° F.

10% 1/2 sec. RS nitrocellulose solution

%		Clear	Blush
85 to 88	Relative Humidity	45%	50%
95 to 98		50%	55%
99		55%	60%

Evaporation Rate at 95° F. in minutes

	5%	25%	50%
85 to 88%	1/4	1 1/2	3 3/4
95 to 98%	1/4	1 1/2	3 1/2
99%	1/4	1 1/2	3 3/4

## ETHYL ACETATE (Cont.)

	75%	90%	95%
85 to 88%	<u>6 3/4</u>	<u>9 1/2</u>	<u>11 1/4</u>
95 to 98%	<u>6</u>	<u>7 3/4</u>	<u>8 1/2</u>
99%	<u>6 1/2</u>	<u>9 1/4</u>	<u>10 1/4</u>

Distillation Range	
85 to 88%	70 to 80°
95 to 98%	73 to 80°
99%	75 to 80°

Dilution Ratio  
(nitrocellulose solution method)  
with

	toluol	petroleum naphtha
85 to 88%	<u>3.5</u>	<u>1.1</u>
95 to 98%	<u>3.2</u>	<u>1.0</u>
99%	<u>3.0</u>	<u>1.0</u>

## ETHYL ACETOACETATE

## Synonyms:

acetoacetic ester      diacetic ether

Formula:  $\text{CH}_3\text{COCH}_2\text{COOC}_2\text{H}_5$

## Characteristics:

colorless to slight yellow  
pleasant, fruity distinct odor

Formula Weight: 130.1

## Melting Point:

-45° C.      -80° C.

## Boiling Point:

181° C. (at 760 mm.) decomposes  
188° C. (at 755 mm.)  
100° C. (at 80 mm.)  
180 to 181° C. (at 760 mm.)  
158.2° C. (at 400 mm.)  
138.0° C. (at 200 mm.)  
118.5° C. (at 100 mm.)  
96.2° C. (at 40 mm.)  
81.1° C. (at 20 mm.)  
67.3° C. (at 10 mm.)  
28.5° C. (at 1 mm.)

Vapor Pressure (mm. Hg): 0.8 at 20° C.

## Specific Gravity:

1.025(20/4)  
1.026 to 1.028(20/20)  
1.027 to 1.030(20/20)  
8.56 lbs. per gal. at 20° C.

## Refractive Index:

1.4198      1.4209

## Surface Tension (dynes per cm.):

34.8 at 0° C.      25.0 at 90° C.  
32.5 at 20° C.

## Flash Point:

185° F., 171° F. (open)  
184° F. (closed)

Heat of Combustion (kilogram-calories per mole): 690.8 (liquid)

## Uses:

organic synthesis      plastics  
chemical      dopes  
intermediate  
manufacture of dyes, lacquers, vitamins  
B<sub>1</sub> and other drugs  
whisky flavors and cherry essences

## Solubility:

4.9% by weight (of water) at 20° C.  
13 grams per 100 ml. (in water)  
at 17° C.

∞ (in alcohol)      ∞ (in chloroform)  
∞ (in ether)      ∞ (in benzene)

## Additional Data:

should be stored away from light  
coefficient of expansion,  
0.00056 per ° F.      0.00106 per ° C.  
vapor density, 4.48

## ETHYL ACETYLGLYCOLATE

## Synonyms:

acetylglycolic acid ethyl ester

Formula:  $\text{CH}_3\text{COOCH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 146.1

Boiling Point: 180° C. (at 760 mm.)

Specific Gravity: 1.099 at 17° C.

## Solubility:

very slightly soluble in water

## ETHYL ACETYLSALICYLATE

## Synonyms:

acetylsalicylic acid ethyl ester  
Alexipon

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_4\text{COOC}_2\text{H}_5$

Formula Weight: 208.2

Boiling Point:

272° C. (at 760 mm.)

slight decomposition

Specific Gravity: 1.157 at 15° C.

Solubility:

insoluble and decomposes in water

soluble in alcohol, ether, and many organic solvents

### ETHYL ACRYLATE

Synonyms: acrylic acid ethyl ester

Formula:  $\text{CH}_2\text{:CHCOOC}_2\text{H}_5$

Formula Weight: 100.1

Melting Point:

-71.2° C.

freezing point, -46° C.

Boiling Point:

99.8 to 101° C. (at 760 mm.)

99 to 100° C. (at 760 mm.)

Specific Gravity:

0.925 at 15° C. 0.924(20/4)

0.919 at 20° C.

7.65 lbs. per gal.

Refractive Index:

1.405 1.403 at 25° C.

Flash Point: 48° F. (open)

Uses: organic syntheses

Solubility:

very slightly soluble in water

∞ (in alcohol) ∞ (in ether)

Additional Data:

the commercial product contains an inhibitor

### ETHYL ADIPATE

Synonyms:

adipic acid diethyl ester

adipic acid ethyl ester

diethyl adipate

Formula:  $(\text{CH}_2\text{CH}_2\text{COOC}_2\text{H}_5)_2$

Formula Weight: 202.2

Melting Point: -21° C.

Boiling Point:

239 to 241° C. (at 761 mm.)

240° C. (at 760 mm.)

Specific Gravity: 1.009(20/4)

Solubility (grams per 100 ml.):

0.43 (in water) at 30° C.

soluble in alcohol soluble in ether

### ETHYL ALCOHOL

Synonyms:

alcohol methyl carbinol

Cologne spirit spirits of wine

ethanol Ansol

ethyl hydroxide Mersol

ethylic alcohol Nealco

fermentation Shellacol

alcohol Solox

grain alcohol

Formula:  $\text{C}_2\text{H}_5\text{OH}$

Characteristics:

volatile limpid

very mobile

ethereal, vinous, pleasant odor

pungent, burning taste

no residual odor

Formula Weight: 46.7

Melting Point: -117.3 to -112° C.

Boiling Point: 78.4° C. (at 760 mm.)

Specific Gravity:

0.7893(20/4) 0.7905(20/20)

0.7851(25/4)

6.6 lbs. per gal. at 20° C.

Refractive Index:

1.361 at 20° C. 1.3633 at 15° C.

Surface Tension (dynes per cm.):

air vapor

24.05 at 0° C. 22.75 at 20° C.

22.27 at 20° C. 20.14 at 50° C.

18.22 at 70° C. 15.47 at 100° C.

## ETHYL ALCOHOL (Cont.)

## Viscosity (centipoises):

1.773 at 0° C.	0.834 at 40° C.
1.466 at 10° C.	0.702 at 50° C.
1.200 at 20° C.	0.592 at 60° C.
1.003 at 30° C.	0.504 at 70° C.

## Inflammability Range (volume per cent in air):

3.28 (lower limit)	19 (upper limit)
--------------------	------------------

## Flash Point:

65° F. (open)	57° F. (closed)
---------------	-----------------

## Specific Heat (gram-calories per g. per ° C.):

0.581 at 25° C. (liquid)

## Heat of Vaporization (gram-calories per g.):

204 at 15° C.

## Heat of Fusion (gram-calories per g.):

24.9 at 15° C.

## Heat of Combustion (kilogram-calories per mole):

328 (liquid)

## Uses:

chemical analyses, artificial flowers, leather, silk, casing fluids, celluloid products, cements and preparations, chewing tobacco, cleaning fluids, cocoa butter, collodion, confectioners' colors, cutting oils, dental preparations, digestive ferments, dyes, emulsions, fertilizers, films, flavor solvent, food colors, foot powder, fur treatment, gas mantles, glass, glass enamel, glue, gums, hats, hypodermic tablets, imitation ivory goods, imitation leather, imitation rubber, incandescent lamp filaments, incense, inks, insecticides, insulin, intermediates, iodizers, iriscin, isinglass, Japans, jewelry, lacquers, leather treatment, lotions, lozenges, meat branding inks, milk protein, motor fuel, oils, optical goods, organic compounds, paints, paper, pastes, pencils, perfumes, pyroxylin products, resins, rubbing alcohols, shampoo products, shellac products, smokeless powder, soaps, soldering flux, stencil products, sutures, thermometers, tobacco, toilet preparations, tooth paste,

transparent paper, transparent soap, varnish products, vitamin extractions, watches, wood finish, and wool fat

## Solubility:

∞ (of water) ∞ (in chloroform)  
 ∞ (in water) ∞ (in methyl  
 ∞ (in ether) alcohol)  
 miscible with many organic solvents

## Additional Data:

inflammable hygroscopic  
 should be stored in tightly closed containers and away from flames  
 azeotrope with water boils at 78.15° C. and contains 95.5% by weight of ethyl alcohol  
 coefficient of expansion, 0.00063 per ° F. 0.00103 per ° C.  
 vapor density, 1.59  
 electrical conductivity,  $1.35 \times 10^{-9}$  mhos at 25° C.  
 weight of pure vapor, 2100 mg./l.  
 critical temperature, 243.4° C.  
 critical pressure, 63.1 atm.  
 autoignition temperature, 799° F.  
 apparent ignition temperature in air, 700 to 800° F.

## ETHYL ALCOHOL 95%

Vapor Pressure (mm. Hg): 43.0 at 20° C.

## Specific Gravity:

6.73 lbs. per gal. at 20° C.

Refractive Index: 1.3651 at 15° C.

Surface Tension (dynes per cm.): 22.8

Viscosity (centipoises): 1.41

Flash Point: 57° F. (open)

Specific Heat (gram-calories per g. per ° C.): 0.618 at 23° C. (liquid)

## ETHYL ALLYLACETOACETATE

## Synonyms:

allylacetoacetic acid ethyl ester

Formula:  $\text{CH}_3\text{COCH}(\text{C}_3\text{H}_5)\text{COOC}_2\text{H}_5$

Formula Weight: 170.2

## Boiling Point:

206° C. (at 760 mm.)  
slight decomposition

Specific Gravity: 0.992(17.6/4)

## ETHYLAMINE

## Synonyms:

aminoethane                      monoethylamine

Formula:  $C_2H_5NH_2$

Characteristics: ammonia odor

Formula Weight: 45.1

Melting Point: -80.6° C.

Boiling Point: 16.6° C. (at 760 mm.)

Specific Gravity:

0.689(15/15)                      0.7054(0/4)

Surface Tension (dynes per cm.):

28.9 at -74° C.                      21.3 at 0° C.  
23.2 at -21.5° C.                      20.3 at 9.9° C.  
(in N)

Heat of Vaporization (gram-calories per g.): 14.57 at 15° C.

Heat of Combustion:

9058 gram-calories per g.  
408.5 kilogram-calories per mole  
(liquid)  
9157 gram-calories per g. (vapor)

## Uses:

solvent for many organic compounds  
in petroleum and vegetable oil  
refining  
intermediate for dyes, sizing, and  
wetting compounds  
emulsifying agent for waxes  
latex stabilizer  
vulcanization accelerator  
plastic processing  
ceramic deflocculation agent  
drug synthesis  
photographic dye synthesis

## Solubility:

$\infty$  (in water)                       $\infty$  (in alcohol)  
    $\infty$  (in ether)

soluble in methyl alcohol, acetone,  
benzene, gasoline, and ethyl acetate

## Additional Data:

should be stored in tightly closed  
containers in cold  
inflammable                      strongly alkaline  
dissociation constant at 25° C.,  
5.6 x 10<sup>-4</sup>  
critical temperature, 183.2° C.  
critical pressure, 55.5 atm.  
heat of solution in water at 19° C.,  
6330 cal./mol. of solute at infinite  
solution

pH of Aqueous Solutions at 25° C.

Normality	pH
1.0	12.50
0.5	12.20
0.1	11.90
0.05	11.73
0.01	11.28
0.001	10.57

## ETHYLAMINE 70%

Formula:  $C_2H_5NH_2$  aqueous

Specific Gravity:

0.778 to 0.802(20/20)  
6.55 lbs. per gal.

Flash Point: < 0° F. (open)

ETHYL m-AMINO BENZOATE

Synonyms:

aminobenzoic acid ethyl ester

Formula:  $NH_2C_6H_4COOC_2H_5$

Characteristics: oily

Formula Weight: 165.2

Boiling Point: 294° C.

Solubility:

slightly soluble in hot water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

 $\beta$ -ETHYLAMINOETHANOL

Synonyms:

2-ethylaminoethanol  
ethyl ethanolamine

Formula:  $C_2H_5NHCH_2CH_2OH$

$\beta$ -ETHYLAMINOETHANOL (Cont.)

Characteristics: oily

Formula Weight: 89.1

Solidification Point: -8.8° C.

Boiling Point:

167 to 169° C. (at 751 mm.)

161 to 174° C. (at 760 mm.)

Specific Gravity:

0.914(20/4)

7.66 lbs. per gal.Refractive Index: 1.444

Viscosity (centipoises):

12.40 at 25° C.3.22 at 60° C.Flash Point: 160° F. (closed)

Solubility:

very soluble in water, alcohol, and ether

soluble in methyl alcohol, acetone, benzene, gasoline, and ethyl acetate

Additional Data:

coefficient of expansion,  
0.00091 per ° C.

pH at 25° C.

Normality

pH

1.0

11.91

0.5

11.74

0.1

11.35

0.05

11.15

0.01

10.80

0.001

10.04

## ETHYL AMYLMALONATE

Synonyms:

amyl malonic acid (di) ethyl ester  
diethyl amylmalonateFormula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}(\text{COOC}_2\text{H}_5)_2$ 

Formula Weight: 230.3

Boiling Point: 121 to 123° C. (at 6 mm.)

Refractive Index: 1.4253

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

N-ETHYLANILINE

Synonyms:

N-ethylphenylamineN-monoethylanilineFormula:  $\text{C}_6\text{H}_5\text{NHC}_2\text{H}_5$ 

Characteristics:

highly refractive straw color  
odor of aniline

Formula Weight: 121.2

Melting Point: -63.5° C.

Boiling Point:

204.7° C. (at 760 mm.)

203 to 206° C. (at 760 mm.)

Specific Gravity:

0.9631(20/4)

0.963(20/20)

0.958(25/25)

8.0 lbs. per gal.

Refractive Index:

1.5559 at 20.3° C.

1.554

Viscosity (centipoises):

2.25 at 20° C.

1.01 at 60° C.

Flash Point: 185° F. (open)

Uses:

dye intermediate      organic syntheses

Solubility:

insoluble in water     $\infty$  (in alcohol)  
 $\infty$  (in ether)soluble in benzene, methyl alcohol,  
acetone, gasoline, ethyl acetate

miscible with many organic compounds

Additional Data:

turns brown on exposure to light and air

should be stored in tightly closed  
containers and away from light  
solidifies below -80° C.m-ETHYLANILINESynonyms: m-aminoethylbenzeneFormula:  $\text{NH}_2\text{C}_6\text{H}_4\text{C}_2\text{H}_5$ 

Formula Weight: 121.2

Melting Point: -64° C.

## Boiling Point:

205° C. (at 760 mm.)

214 to 215° C. (at 760 mm.)

## Specific Gravity:

0.990 at 0° C.

0.9631(20/4)

## Solubility:

slightly soluble in water

very soluble in alcohol

very soluble in ether

o-ETHYLANILINESynonyms: o-aminoethylbenzeneFormula:  $\text{NH}_2\text{C}_6\text{H}_4\text{C}_2\text{H}_5$ 

Formula Weight: 121.2

Melting Point: -43° C.

## Boiling Point:

214.3 to 216° C. (at 760 mm.)

Specific Gravity: 0.983(22/4)

## Solubility:

slightly soluble in water

very soluble in alcohol

very soluble in ether

p-ETHYLANILINESynonyms: p-aminoethylbenzeneFormula:  $\text{NH}_2\text{C}_6\text{H}_4\text{C}_2\text{H}_5$ 

Formula Weight: 121.2

## Melting Point:

-5° C.

-4° C.

Boiling Point: 217.4° C. (at 760 mm.)

## Specific Gravity:

0.975(12/4)

0.976 at 22° C.

## Solubility:

slightly soluble in water

very soluble in alcohol

very soluble in ether

## ETHYL ANISATE

Synonyms: anisic acid ethyl ester

Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{COOC}_2\text{H}_5$ 

## Characteristics:

pleasant aromatic odor

sour-sweet taste

aromatic flavor

Formula Weight: 180.2

Melting Point: 7 to 8° C.

## Boiling Point:

269 to 270° C. (at 760 mm.)

134 to 135° C. (at 20 mm.)

## Specific Gravity:

1.103(25/25)

1.1028(15/15)

Uses: apple, pear, and plum flavors

## Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## ETHYL ANTHRANILATE

## Synonyms:

anthranilic acid ethyl ester

ethyl o-amino-benzoateFormula:  $\text{NH}_2\text{C}_6\text{H}_4\text{COOC}_2\text{H}_5$ 

## Characteristics:

pleasant odor resembling orange blossom

sweet taste becoming harsh

orange flavor and aroma

Formula Weight: 165.2

Melting Point: 13° C.

Boiling Point: 260 to 268° C. (at 760 mm.)

Specific Gravity: 1.1174(20/4)

## Solubility:

very slightly soluble in water

soluble in alcohol

soluble in ether

## ETHYLARSINE

Synonyms: arsinoethane

Formula:  $\text{C}_2\text{H}_5\text{AsH}_2$ 

Formula Weight: 106.0

Boiling Point: 36° C. (at 760 mm.)

## ETHYLARSINE (Cont.)

Specific Gravity: 1.217(22/4)

## Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## ETHYL AZELATE

Synonyms: diethyl azelate

Formula:  $\text{CH}_2[(\text{CH}_2)_3\text{COOC}_2\text{H}_5]_2$ 

Formula Weight: 244.3

## Boiling Point:

291 to 292° C. (at 760 mm.)
151 to 153° C. (at 14 mm.)

Specific Gravity: 0.973(20/4)

## Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## ETHYLBENZENE

## Synonyms:

ethylbenzol	phenylethane
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Formula:  $\text{C}_6\text{H}_5\text{C}_2\text{H}_5$ 

Formula Weight: 106.2

Melting Point: -94.9 to -92.8° C.

## Boiling Point:

134.6 to 136.2° C. (at 760 mm.)

## Specific Gravity:

0.8669(20/4)	0.866(25/25)
<u>7.21 lbs. per gal.</u> at 25° C.	

## Refractive Index:

1.493 at 25° C.	1.49584
1.4983 at 14.5° C.	

## Surface Tension (dynes per cm.):

31.4 at 0° C.	24.9 at 60° C.
29.2 at 20° C.	

## Viscosity (centipoises):

0.8769 at 0° C.	0.5311 at 40° C.
0.6687 at 20° C.	0.2512 at 130° C.

## Flash Point:

<u>75° F.</u> (open)	<u>59° F.</u> (closed)
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## Specific Heat (Btu./lb./° F.):

0.41 (liquid) at 89.4° F.

## Heat of Vaporization:

81.2 gram-calories per g. at 15° C.
145.7 Btu. per lb. at the boiling point
171.09 Btu. per lb. at 77° F.

## Heat of Fusion (gram-calories per g.):

20.6 at 15° C.

## Heat of Combustion (kilogram-calories

per mole): 1091.2 (liquid)

## Uses:

organic syntheses	diluent
solvent	
organic chemical intermediate	

## Solubility (grams per 100 ml.):

0.014 (in water) at 15° C.	
$\infty$ (in alcohol)	$\infty$ (in benzene)
$\infty$ (in ether)	$\infty$ (in carbon tetrachloride)

miscible with common organic solvents

## Additional Data:

inflammable  
 solidifies below -70° C.  
 fire point, 70° F.  
 dielectric constant, 1000 cycles, 2.3  
 dielectric strength, volts at 0.1" gap,  
>30,000  
 power factor, 1000 cycles, 0.84%  
 specific resistivity, ohms/cm.,  
 $3.6 \times 10^{12}$   
 vapor density, 3.66  
 aniline point, <-22° F.  
 critical temperature, 346.4° C.  
 critical pressure, 38.1 atm.  
 coefficient of expansion,  
 0.00056 at 32 to 104° F.  
 total heating values (at 77° F.),  
 18,487 Btu./lb.  
 133,080 Btu./cu. ft.-gas

## ETHYL BENZENESULFONATE

## Synonyms:

benzenesulfonic acid ethyl ester

Formula:  $\text{C}_6\text{H}_4\text{SO}_3\text{C}_2\text{H}_5$ 

## Characteristics:

colorless to pale yellow
nearly odorless

Formula Weight: 186.2

Boiling Point: 156° C. (at 15 mm.)

Specific Gravity: 1.219(17/4)

Solubility:

decomposes in hot water

∞ (in alcohol)      ∞ (in chloroform)

∞ (in ether)      ∞ (in benzene)

### ETHYL BENZOATE

Synonyms:

benzoic acid ethyl ester

benzoic ether

ethyl benzenecarboxylate

Formula:  $C_6H_5COOC_2H_5$

Characteristics:

refractive

aromatic, fruity and clove odor

harsh, bitter taste

strawberry flavor

Formula Weight: 150.2

Melting Point: -34.6 to -32.7° C.

Boiling Point: 211 to 213° C. (at 760 mm.)

Specific Gravity:

1.052(15/15)      1.050(25/4)

1.0509(15/4)

Refractive Index:

1.5068 at 17.3° C.      1.506

Surface Tension (dynes per cm.):

37.5 at 0° C.      30.0 at 75° C.

35.5 at 20° C.

Viscosity (centipoises):

2.242 at 20° C.      2.014 at 25° C.

Heat of Vaporization (gram-calories per g.): 69.5 at 15° C.

Heat of Combustion (kilogram-calories per mole): 1098.7 (liquid)

Uses:

perfumes

flavoring extracts

solvent for cellulose derivatives and resins

solvent mixtures

Solubility (grams per 100 ml.):

0.08 (in water) at 20° C.

∞ (in ether)

very soluble in alcohol

very soluble in chloroform

very soluble in petroleum ether

one volume dissolves in 8 volumes of 60% alcohol, and 2 volumes of 70% alcohol

Additional Data: vapors cause coughing

### ETHYL BENZOYLACETATE

Synonyms:

benzoylacetic ester

ethyl β-ketohydrocinnamate

Formula:  $C_6H_5COCH_2COOC_2H_5$

Characteristics:

pale yellow

whisky-like odor

Formula Weight: 192.2

Melting Point: 0° C.

Boiling Point:

165 to 167° C. (at 20 mm.)

265 to 270° C. (at 760 mm.) decomposes

144 to 148° C. (at 10 mm.)

Specific Gravity:

1.111(25/4)

1.111 to

1.122(20/4)

1.117(20/20)

9.28 lbs. per gal. at 20° C.

Refractive Index: 1.53115 at 16° C.

Flash Point: 285° F. (open)

Uses:

dye intermediate

organic syntheses

synthetic alcoholic beverages

Solubility:

very slightly soluble in water

∞ (in alcohol)      ∞ (in ether)

Additional Data:

coefficient of expansion,

0.00044 per ° F.      0.00079 per ° C.

### ETHYL BENZOYLACETOACETATE

Synonyms:

benzoylacetoacetic acid ethyl ester

benzoylacetoacetic ester



Formula:  $\text{CH}_2\text{BrCOOC}_2\text{H}_5$

Characteristics:

colorless to pale yellow  
mild sweet odor that rapidly becomes  
sharp and stringent

Formula Weight: 167.0

Melting Point:

-13.8° C.                      -40° C.

Boiling Point:

159 to 160° C. (at 760 mm.)  
57 to 59° C. (at 15 mm.)  
158 to 160° C. (at 760 mm.)

Specific Gravity:

1.506(20/20)                      1.484(25/25)  
1.514(13/4)  
12.5 lbs. per gal. at 25° C.

Refractive Index:

1.451                      1.4470 at 25° C.

Uses:

manufacture of tear gases  
organic syntheses

Solubility:

insoluble in water       $\infty$  (in carbon  
 $\infty$  (in alcohol)              tetrachloride)  
 $\infty$  (in ether)              soluble in benzene

Additional Data:

very irritating to the eyes  
vapor density, 5.8

ETHYL  $\alpha$ -BROMOACETOACETATE

Synonyms:

$\alpha$ -bromoacetoacetic acid ethyl ester

Formula:  $\text{CH}_3\text{COCHBrCOOC}_2\text{H}_5$

Formula Weight: 209.1

Boiling Point:

210 to 215° C. (at 760 mm.) decomposes

Specific Gravity: 1.429(14/4)

ETHYL  $\alpha$ -BROMOBUTYRATE

Synonyms:

$\alpha$ -bromobutyric acid ethyl ester  
ethyl 2-bromobutanoate

Formula:  $\text{C}_2\text{H}_5\text{CHBrCOOC}_2\text{H}_5$

Formula Weight: 159.1

Boiling Point:

177 to 179° C. (at 760 mm.) decomposes  
177.5° C. (at 765 mm.)  
58 to 67° C. (at 10 mm.)

Specific Gravity:

1.330(20/20)                      1.321(25/4)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

Additional Data:

should be protected from light

ETHYL  $\alpha$ -BROMOCAPROATE

Synonyms:

$\alpha$ -bromocaproic acid ethyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CHBrCOOC}_2\text{H}_5$

Formula Weight: 223.1

Boiling Point: 205 to 210° C. (at 760 mm.)

ETHYL  $\alpha$ -BROMOISOBUTYRATE

Synonyms:

$\alpha$ -bromoisobutyric acid ethyl ester  
ethyl 2-bromo-2-methylpropanoate

Formula:  $(\text{CH}_3)_2\text{CBrCOOC}_2\text{H}_5$

Formula Weight: 195.1

Boiling Point:

164° C. (at 760 mm.) decomposes  
163.3° C. (at 762 mm.)

Specific Gravity:

1.329(20/20)                      1.311(25/4)

Solubility:

insoluble in water       $\infty$  (in ether)  
very soluble in alcohol

ETHYL  $\alpha$ -BROMOISOVALERATE

Synonyms:

$\alpha$ -bromoisovaleric acid ethyl ester

Formula:  $(\text{CH}_3)_2\text{CHCHBrCOOC}_2\text{H}_5$

Formula Weight: 209.1

Boiling Point: 186° C. (at 760 mm.)

Specific Gravity: 1.278(12/12)

ETHYL  $\alpha$ -BROMOPROPIONATE

## Synonyms:

$\alpha$ -bromopropionic acid ethyl ester  
ethyl 2-bromopropanoate

Formula:  $\text{CH}_3\text{CHBrCOOC}_2\text{H}_5$ 

## Characteristics:

pungent, sharp odor  
colorless

Formula Weight: 181.0

## Boiling Point:

159 to 161°C. (at 760 mm.)  
160 to 165°C. (at 760 mm.)  
slight decomposition

## Specific Gravity:

1.394(20/4)                      1.447(20/20)

Refractive Index: 1.4469

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
    $\infty$  (in ether)

## Additional Data:

turns yellow when exposed to light  
should be protect from light

ETHYL  $\beta$ -BROMOPROPIONATE

## Synonyms:

 $\beta$ -bromopropionic acid ethyl esterFormula:  $\text{CH}_2\text{BrCH}_2\text{COOC}_2\text{H}_5$ 

Formula Weight: 181.0

Boiling Point: 72 to 75°C. (at 15 mm.)

Specific Gravity: 1.261 at 15°C.

ETHYL  $\alpha$ -BROMOVALERATE

## Synonyms:

$\alpha$ -bromovaleric acid ethyl ester  
ethyl 2-bromopentanoate

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CHBrCOOC}_2\text{H}_5$ 

Formula Weight: 209.1

## Boiling Point:

190 to 192°C. (at 760 mm.)  
74 to 76°C. (at 11 mm.)

Specific Gravity: 1.226(18/4)

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
    $\infty$  (in ether)

## 2-ETHYL-1-BUTANOL

## Synonyms:

ethylbutanol  
2-ethylbutyl alcohol  
hexyl alcohol  
3-methylolpentane  
pseudohexyl alcohol

Formula:  $(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{OH}$ 

Formula Weight: 102.2

Melting Point: &lt; -15°C.

## Boiling Point:

149.5°C. (at 760 mm.)  
140 to 160°C. (at 760 mm.)  
148 to 149°C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.9 at 20°C.

## Specific Gravity:

0.8328(20/20)  
6.9 lbs. per gal. at 20°C.

## Refractive Index:

1.421                      1.4229

Surface Tension (dynes per cm.):

28.05 at 28°C.Viscosity (poises): 0.053 at 20°C.Flash Point: 135°F. (open)Specific Heat (gram-calories per g.  
per °C.):0.586 (liquid) at the boiling point

## Uses:

organic syntheses  
solvent for drugs, dyes, flavors,  
gums, oils, perfumes, resins,  
and waxes

Solubility (grams per 100 ml.):

4.56 (of water)  
0.63 at 24°C.  
0.43 at 20°C. (in water)  
soluble in alcohol    soluble in ether

## Additional Data:

coefficient of expansion,  
0.000842 per °C. to 20°C.,  
0.000921 per °C. to 55°C.

## 2-ETHYLBUTYL ACETATE

## Synonyms:

acetic acid 2-ethylbutyl ester

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}(\text{C}_2\text{H}_5)_2$ 

Characteristics: mild odor

Formula Weight: 144.2

## Boiling Point:

162.4° C. (at 760 mm.)157 to 164° C. (at 760 mm.)

## Vapor Pressure (mm. Hg):

1.8 at 20° C.5 at 30° C.

## Specific Gravity:

0.8803(20/20)7.3 lbs. per gal. at 20° C.Refractive Index: 1.4103 at 20° C.Flash Point: 130° F. (open)

## Uses:

solvent for gums, lacquers, nitro-cellulose, printing inks, and resins  
high boiling solvent for brushing lacquers

## Solubility (grams per 100 ml.):

0.57 (of water)0.06 (in water) at 25° C.

## Additional Data:

dilution ratios,

with xylene . . . . . 2.0with mineral spirits . . . . . 1.1

coefficient of expansion,

0.00106 at 10 to 30° C.

## 2-ETHYL-1-BUTYLAMINE

## Synonyms:

hexylamine

1-amino-2-ethyl-n-butane

 $\beta$ -ethylbutylamineFormula:  $(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{NH}_2$ 

Formula Weight: 101.2

Boiling Point: 125.3° C. (at 760 mm.)

## Solubility:

soluble in water  $\infty$  (in alcohol) $\infty$  (in ether)

## N-ETHYLBUTYLAMINE

Formula:  $\text{C}_2\text{H}_5\text{NHCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ 

Characteristics: amine odor

Formula Weight: 101.2

Boiling Point: 110 to 113° C. (at 760 mm.)Specific Gravity: 0.739(20/20)Refractive Index: 1.407

## Solubility:

insoluble in water

soluble in methyl alcohol, ether,  
acetone, benzene, gasoline, and ethyl  
acetate

## 2-ETHYLBUTYL CELLOSOLVE

## Synonyms:

ethylene glycol ethylbutyl ether

2[2-ethylbutoxy]ethanol

Formula:  $(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{OCH}_2\text{CH}_2\text{OH}$ 

Formula Weight: 146.2

Freezing Point: < -90° C.

## Boiling Point:

196.8° C. (at 760 mm.)84° C. (at 10 mm.)Vapor Pressure (mm. Hg): 0.17 at 20° C.

## Specific Gravity:

0.8954(20/20)7.45 lbs. per gal. at 20° C.Refractive Index: 1.4305

## Viscosity (centipoises):

5.86 absolute viscosity at 20° C.Flash Point: 180° F. (open)

## Uses:

solvent for dyes and wood stains  
plasticizer intermediate  
mutual solvent for making 2 phases  
homogenous which are mutually  
incompatible

## Solubility (grams per 100 ml.):

10.0 (of water) 1.2 (in water)

$\alpha$ -ETHYLBUTYRALDEHYDE

## Synonyms:

diethylacetaldehyde  
2-ethylbutanal  
2-ethylbutyraldehyde

Formula:  $(C_2H_5)_2CHCHO$ 

Formula Weight: 100.2

## Boiling Point:

116 to 118° C. (at 760 mm.)  
80 to 135° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 13.7 at 20° C.

## Specific Gravity:

0.8164(20/20)      0.818(20/4)  
6.8 lbs. per gal. at 20° C.

## Uses:

organic syntheses      rubber accelerator  
pharmaceuticals      synthetic resins  
plasticizers

Solubility (grams per 100 ml.):

0.78 (of water)  
0.3 (in water) at 20° C.  
 $\infty$  (in alcohol)       $\infty$  (in ether)

## ETHYL BUTYRATE

## Synonyms:

butyric acid ethyl ester  
ethyl butanoate

Formula:  $C_2H_5CH_2COOC_2H_5$ 

## Characteristics:

fruity, pineapple-like odor  
sweet taste  
pineapple flavor

Formula Weight: 116.2

Melting Point: -93.3° C.

## Boiling Point:

119 to 121° C. (at 760 mm.)  
107 to 131° C. (at 760 mm.)

## Specific Gravity:

0.879(20/4)  
7.32 lbs. per gal. at 20° C.

## Refractive Index:

1.39302 at 18° C.      1.3932

Surface Tension (dynes per cm.):

26.1 at 5° C.      20.6 at 60° C.  
24.54 at 20° C.

Viscosity (centipoises): 0.668 at 20° C.

## Flash Point:

85° F. (open)      78° F. (closed)

Heat of Vaporization (gram-calories per g.): 74.7 at 15° C.

Heat of Combustion (kilogram-calories per mole): 851.2 (liquid)

## Uses:

solvent for cellulose esters and ether,  
fruit flavors, lacquers, perfumes,  
and resins  
safety glass

Solubility (grams per 100 ml.):

0.75 (of water) at 20° C.  
0.68 at 25° C., 0.49 at 20° C.  
(in water)

very soluble in alcohol

very soluble in ether

## Additional Data:

coefficient of expansion,  
0.00116 at 10 to 30° C.

dilution ratios,

with toluene. . . . . 1.9with petroleum naphtha . . . . 0.7vapor density, 4.00

## 2-ETHYLBUTYRIC ACID

## Synonyms:

diethylacetic acid  
2-ethylbutanoic acid  
3-pentanecarboxylic acid

Formula:  $(C_2H_5)_2CHCOOH$ 

## Characteristics:

odor similar to that of caproic acid

Formula Weight: 116.2

Melting Point: &lt;-15° C.

## Boiling Point:

190° C. (at 760 mm.)  
194 to 197° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.08 at 20° C.

## Specific Gravity:

0.9195(18/4)      0.9225(20/20)

0.9331(10/4)

7.7 lbs. per gal. at 20° C.

Refractive Index: 1.4179 at 10° C.

Flash Point: 210° F. (open)Heat of Combustion (kilogram-calories  
per mole): 830.8 (liquid)

## Uses:

organic syntheses of intermediates  
for manufacture of drugs and dyes

Solubility (grams per 100 ml.):

3.3 (of water) at 20° C.0.22 (in water) at 20° C.

slightly soluble in water

soluble in alcohol      soluble in ether

*d*-ETHYLBUTYRONITRILE

## Synonyms:

3-cyanopentane

diethylacetoneitrile

2-ethylbutanenitrile

Formula:  $(C_2H_5)_2CHCN$ 

Characteristics: oily

Formula Weight: 97.2

Boiling Point: 144 to 146° C. (at 760 mm.)

Solubility:

 $\infty$  (in alcohol)       $\infty$  (in ether)

## ETHYL CAPRATE

## Synonyms:

capric acid ethyl ester

ethyl decanoate

Formula:  $CH_3(CH_2)_8COOC_2H_5$ 

Characteristics:

has a winey odor on dilution

sweet taste      brandy flavor

Formula Weight: 200.3

Melting Point: -19.96° C.

Boiling Point:

244.6° C. (at 758 mm.)

224.5° C. (at 760 mm.)

110 to 112° C. (at 10 mm.)

Specific Gravity: 0.8650(20/4)

Refractive Index: 1.42575

## Uses:

cognac essence      wine bouquet  
butterscotch, plum, and pineapple  
flavors

Solubility:

insoluble in water       $\infty$  (in ether) $\infty$  (in alcohol)       $\infty$  (in chloroform)

## 2-ETHYLCAPROALDEHYDE

## Synonyms:

butylethylacetaldehyde

2-ethylhexaldehyde

2-ethylhexanal

octaldehyde

octyl aldehyde

Formula:  $C_4H_9CH(C_2H_5)CHO$ 

Characteristics:

mild characteristic odor

Formula Weight: 128.2

Melting Point: &lt; -100° C.

Boiling Point:

163 to 164° C. (at 760 mm.)

163.4° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 1.8 at 20° C.

Specific Gravity:

0.823(20/4)      0.820(20/20)

6.8 lbs. per gal. at 20° C.

Refractive Index: 1.416

Flash Point: 125° F. (open)

## Uses:

organic syntheses  
possible ingredient for perfumes

Solubility (grams per 100 ml.):

0.04 (of water) at 20° C.

0.04 at 28° C., 0.07 at 20° C.

(in water)

miscible with most organic solvents

## ETHYL CAPROATE

## Synonyms:

caproic acid ethyl ester  
 caproic ether            ethyl capronate  
 capronic ether        ethyl hexanoate

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{COOC}_2\text{H}_5$

## Characteristics:

colorless to yellow  
 pleasant odor like that of ethyl caprate

Formula Weight: 144.2

Melting Point:  $-67.5^\circ\text{C}$ .

## Boiling Point:

165 to  $166^\circ\text{C}$ . (at 736 mm.)  
 166 to  $168^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.873(20/20)            0.8710(20/4)

Refractive Index: 1.40727

## Uses:

organic syntheses    fruit flavors  
 synthetic apple and pear esters

## Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

## ETHYL CAPRYLATE

## Synonyms:

caprylic acid ethyl ester  
 caprylic ether  
 ethyl octanoate  
 ethyl octylate

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{COOC}_2\text{H}_5$

## Characteristics:

pineapple odor        sweet taste  
 very mobile            pineapple flavor

Formula Weight: 172.3

## Melting Point:

$-45^\circ\text{C}$ .                     $-43.1^\circ\text{C}$ .  
 $-48^\circ\text{C}$ .

## Boiling Point:

$208^\circ\text{C}$ . (at 760 mm.)  
 207 to  $208^\circ\text{C}$ . (at 753 mm.)

## Specific Gravity:

0.878 at  $17^\circ\text{C}$ .            0.8667(20/4)

Refractive Index: 1.41775

Heat of Vaporization (gram-calories  
 per g.): 60.5 at  $15^\circ\text{C}$ .

## Uses:

flavors  
 fruit essences, e.g., currant, pear,  
 orange, pineapple, strawberry, and  
 tangerine

Solubility (grams per 100 ml.):

0.063 (in water) at  $20^\circ\text{C}$ .  
 very soluble in alcohol  
 very soluble in ether

## ETHYL CARBONATE

## Synonyms:

carbonic acid (di) ethyl ether  
 diethyl carbonate

Formula:  $(\text{C}_2\text{H}_5)_2\text{CO}_3$

## Characteristics:

inflammable  
 mild, non-residual odor

Formula Weight: 118.1

Melting Point:  $-43^\circ\text{C}$ .

## Boiling Point:

$125.8^\circ\text{C}$ . (at 760 mm.)  
 $126^\circ\text{C}$ . (at 759 mm.)  
 $120$  to  $130^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.9751(20/4)  
0.973 to 0.977(20/20)  
8.11 lbs. per gal. at  $20^\circ\text{C}$ .

## Refractive Index:

1.38456                    1.3852

Surface Tension (dynes per cm.):

26.31 (in air)

Viscosity (centipoises):

10%  $1\frac{1}{2}$  sec. nitrocellulose solution,  
141

## Flash Point:

$115^\circ\text{F}$ . (open)             $77^\circ\text{F}$ . (closed)

Heat of Vaporization (gram-calories  
 per g.): 73.1 at  $15^\circ\text{C}$ .

Heat of Combustion (kilogram-calories per mole): 647.9 (liquid)

Uses:  
solvent for nitrocellulose, cellulose ethers, resins, neutral lacquer solvent, and medium evaporating radio tube cathode fixing lacquers organic syntheses

Solubility (cc. per 100 ml.):  
1.4 (of water) at 25° C.  
insoluble in water  
∞ (in alcohol)  
∞ (in ether)  
miscible with alcohols, ketones, esters, aromatic hydrocarbons, and aliphatic solvents

Additional Data:  
vapor density, 4.07  
coefficient of expansion,  
0.00063 per ° F.    0.00113 per ° C.  
dilution ratios (nitrocellulose solution method),  
with toluene . . . . . 0.6  
with petroleum naphtha . . . . 0.4

Blush Resistance at 90° F.  
10% 1/2 sec. RS nitrocellulose solution

	Clear	Blush
Relative humidity	85%	90%

Evaporation Rate at 95° F.

%	Minutes
5	1 1/4
25	7 1/4
50	14 1/2
75	24
90	31 3/4
95	34 3/4

ETHYL CARBONATE

90% ethyl carbonate, 10% ethyl alcohol

Synonyms: Diatol

Characteristics:  
mild, non-residual odor  
inflammable

Boiling Point: 100 to 130° C. (at 760 mm.)

Specific Gravity:  
0.967 to 0.971(20/20)  
8.06 lbs. per gal. at 20° C.

Viscosity (centipoises):  
10% 1/2 sec. nitrocellulose solution, 69

Flash Point: 82° F. (open)

Uses:  
medium evaporating nitrocellulose solvent  
lacquer solvent       radio tubes

Solubility (cc. per 100 ml.):  
3.0 (of water) at 25° C.

Additional Data:  
coefficient of expansion,  
0.00063 per ° F.    0.00113 per ° C.  
dilution ratios, (nitrocellulose solution method),  
with toluene . . . . . 1.2  
with petroleum naphtha . . . . 0.6

Blush Resistance at 90° F.  
(10% 1/2 sec. RS nitrocellulose solution)

	Clear	Blush
Relative humidity	75%	80%

Evaporation Rate at 95° F.

%	Minutes
5	3/4
25	5 3/4
50	14
75	23 3/4
90	31 1/4
95	35

ETHYL CHAULMOOGRATE

Synonyms:  
chaulmestrol  
chaulmoogric acid ethyl ester  
moogrol

Formula: C<sub>5</sub>H<sub>7</sub>(CH<sub>2</sub>)<sub>12</sub>COOC<sub>2</sub>H<sub>5</sub>

Characteristics:  
pale yellow       fruity odor

Formula Weight: 308.5

Boiling Point: 230° C. (at 20 mm.)

Specific Gravity:  
0.906(15/4)       0.904(25/25)

Solubility:  
insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

## ETHYL CHAULMOOGRATE (Cont.)

## Additional Data:

mixture of ethyl esters of chaulmoogric  
and hydnocarpic acids  
iodine number 90 to 100

## ETHYL CHLOROACETAL

Formula:  $\text{CH}_2\text{ClCH}(\text{OC}_2\text{H}_5)_2$

## Characteristics:

pleasant odor similar to that of acetal

Formula Weight: 152.6

Melting Point:  $< -32^\circ\text{C}$ .

## Boiling Point:

155 to  $157^\circ\text{C}$ . (at 760 mm.)  
56 to  $80^\circ\text{C}$ . (at 20 mm.)

## Specific Gravity:

1.019(20/20)  
1.017 to 1.022 at  $20^\circ\text{C}$ .  
8.5 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.418

Flash Point:  $117^\circ\text{C}$ . (closed)

## Uses:

organic syntheses  
manufacture of various medicinals

## Solubility:

miscible with alcohols, aldehydes,  
amines, esters, ethers, ketones,  
nitroparaffins, aromatic hydro-  
carbons, chlorinated hydrocarbons,  
and lower aliphatic hydrocarbons  
immiscible with water, glycerol,  
ethylene glycol, and higher aliphatic  
hydrocarbons  
forms azeotropic mixtures with ethyl  
acetate, cyclohexanone,  $\alpha$ -pinene,  
camphene, and diisoamyl

## Additional Data:

prolonged exposure to vapors  
irritates the eyes

## ETHYL CHLOROACETATE

## Synonyms:

chloroacetic acid ethyl ester  
ethyl chloracetate  
ethyl chloroethanoate  
ethyl monochlor(o)acetate

Formula:  $\text{CH}_2\text{ClCOOC}_2\text{H}_5$

## Characteristics:

faintly sweetish odor which rapidly  
becomes sharp and stringent

Formula Weight: 122.6

Melting Point:  $-26.0^\circ\text{C}$ .

## Boiling Point:

144.2 to  $146.0^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

1.158(20/4)                      1.169(15.6/15.6)  
1.156(25/25)  
9.67 lbs. per gal. at  $20^\circ\text{C}$ .

## Refractive Index:

1.4227                      1.4198 at  $25^\circ\text{C}$ .

## Uses:

solvent                      vat dyes  
organic syntheses

## Solubility (grams per 100 ml.):

insoluble at  $20^\circ\text{C}$ .  
3.7 at  $80^\circ\text{C}$ . (in water)  
 $\infty$  (in alcohol)                       $\infty$  (in carbon  
ether)                      tetrachloride)

## Additional Data:

vapors irritate the eyes  
vapor density, 4.23 to 4.26

ETHYL  $\alpha$ -CHLOROACETOACETATE

## Synonyms:

$\alpha$ -chloroacetoacetic acid ethyl ester  
ethyl 2-chloro-3-oxobutanoate

Formula:  $\text{CH}_3\text{COCHClCOOC}_2\text{H}_5$

Formula Weight: 164.6

## Boiling Point:

$193^\circ\text{C}$ . (at 760 mm.) decomposes

Specific Gravity: 1.19(14/18)

## Solubility:

very slightly soluble in water  
soluble in alcohol      soluble in ether

ETHYL  $\gamma$ -CHLOROACETOACETATE

## Synonyms:

$\gamma$ -chloroacetoacetic acid ethyl ester  
ethyl 4-chlorooxobutanoate

Formula:  $\text{CH}_2\text{ClCOCH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 164.4

Boiling Point:

200° C. (at 760 mm.)

220° C. (at 756 mm.)

Specific Gravity:

1.218(17/4)

1.176(25/4)

Solubility:

very slightly soluble in water

∞ (in alcohol) ∞ (in ether)

### ETHYL CHLOROFORMATE

Synonyms:

chloroformic acid ethyl ester

ethyl chlorocarbonate

ethyl chloromethanoate

Formula:  $\text{ClCOOC}_2\text{H}_5$

Characteristics:

irritating odor, causes tears

Formula Weight: 108.5

Melting Point: -80.6° C.

Boiling Point: 93 to 95° C. (at 760 mm.)

Specific Gravity:

1.135 to 1.138(20/4)

9.46 lbs. per gal. at 20° C.

Refractive Index: 1.39738

Uses:

organic syntheses

intermediate in manufacture of diethyl  
carbonate and flotation agents

Solubility:

insoluble and decomposes in water

decomposes in alcohol

very soluble in ether, chloroform, and  
benzene

Additional Data:

poisonous

corrosive

vapors irritate eyes and mucous

membranes

coefficient of expansion,

0.00070 per ° F. 0.00126 per ° C.

### ETHYL $\alpha$ -CHLOROPROPIONATE

Synonyms:

$\alpha$ -chloropropionic acid ethyl ester

ethyl 2-chloropropanoate

Formula:  $\text{CH}_3\text{CHClCOOC}_2\text{H}_5$

Characteristics: pleasant odor

Formula Weight: 136.6

Boiling Point:

146.8° C. (at 760 mm.)

146.5° C. (at 760 mm.)

Specific Gravity: 1.087(20/4)

Refractive Index: 1.4185

Solubility:

insoluble in water ∞ (in alcohol)

∞ (in ether)

### ETHYL $\beta$ -CHLOROPROPIONATE

Synonyms:

$\beta$ -chloropropionic acid ethyl ester

ethyl 3-chloropropanoate

Formula:  $\text{CH}_2\text{ClCH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 136.6

Boiling Point: 162 to 163° C. (at 765 mm.)

Specific Gravity: 1.1086(20/4)

Solubility:

very slightly soluble in water

∞ (in alcohol) ∞ (in ether)

### ETHYL CHLOROSULFONATE

Synonyms:

ethyl chlorosulfate sulvinite

Formula:  $\text{C}_2\text{H}_5\text{OSO}_2\text{Cl}$

Characteristics:

oily

fumes in moist air

pungent odor

Formula Weight: 144.6

Boiling Point:

58° C. (at 20 mm.)

152 to 153° C. (at 760 mm.)

Specific Gravity:

1.263 at 18° C.

1.379 at 0° C.

## ETHYL CHLOROSULFONATE (Cont.)

Uses: organic syntheses

## Solubility:

decomposes in water  
soluble in ether, chloroform, and  
benzene

## Additional Data:

very irritant  
vapor density, 5  
volatility,  
18,000 mg. per cm. at 20°C.

trans-ETHYL CINNAMATE

## Synonyms:

cinnamic acid ethyl ester  
cinnamic ether  
ethyl trans-3-phenylpropenoate

Formula:  $C_6H_5CH:CHCOOC_2H_5$

## Characteristics:

heavy balsam odor, strawberry like  
cinnamon odor  
limpid oily liquid  
apricot-peach flavor

Formula Weight: 176.2

Melting Point: 6.5 to 12°C.

## Boiling Point:

271.0°C. (at 760 mm.)  
144°C. (at 15 mm.)

Specific Gravity: 1.049(20/4)

Refractive Index: 1.5598

## Uses:

perfume fixative  
peach, nut, raspberry and strawberry  
flavors  
flavoring extracts  
grape and pear essences

## Solubility:

insoluble in water  
very soluble in alcohol  
 $\infty$  (in ether)  
one volume dissolves in 5 to 7 volumes  
of 70% alcohol solution

## ETHYL CROTONATE

Synonyms: crotonic acid ethyl ester

Formula:  $CH_3CH:CHCOOC_2H_5$

Characteristics: pleasant, stable odor

Formula Weight: 114.1

## Boiling Point:

138°C. (at 748 mm.)  
139°C. (at 760 mm.)

## Specific Gravity:

0.924(15/4)      0.9207(20/20)  
7.65 lbs. per gal. at 20°C.

Refractive Index: 1.4242

## Uses:

solvent and softening agent  
lacquers

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

 $\alpha$ -ETHYLCROTONIC ACID

## Synonyms:

2-ethyl-trans-2-butenic acid  
2-pentene-3-carboxylic acid

Formula:  $CH_3CH:C(C_2H_5)COOH$

Characteristics: oily

Formula Weight: 114.1

Melting Point: -35°C.

Boiling Point: 199.5°C. (at 750 mm.)

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ETHYL CYANATE

Synonyms: cyanic acid ethyl ester

Formula:  $C_2H_5OCN$

Formula Weight: 71.1

## Boiling Point:

162°C. (at 760 mm.) decomposes

## Specific Gravity:

1.127(15/4)      0.89(20/4)

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)



## ETHYL DIACETOACETATE (Cont.)

Formula:  $(C_2H_3O)_2CHCOOC_2H_5$ 

Formula Weight: 172.2

Boiling Point:

200 to 211°C. (at 760 mm.)

slight decomposition

Specific Gravity:

1.089(25/25)

1.104(15/4)

Refractive Index: 1.4695 at 18.3°C.

Solubility:

slightly soluble in water

very soluble in alcohol

very soluble in ether

## ETHYL DIAZOACETATE

Synonyms:

diazooacetic acid ethyl ester

diazooethyl acetate

ethyl diazoethanoate

Formula:  $N_2CHCOOC_2H_5$ 

Characteristics:

yellow

oily

Formula Weight: 114.1

Melting Point: -22°C.

Boiling Point:

140 to 141°C. (at 720 mm.)

Specific Gravity:

1.0852(18/4)

1.073 at 32°C.

Refractive Index: 1.4588 at 17.6°C.

Solubility:

slightly soluble in water

very soluble in alcohol and ether

soluble in benzene and ligroins

## ETHYL DIBROMOACETATE

Synonyms:

dibromoacetic acid ethyl ester

ethyl dibromoethanoate

Formula:  $CHBr_2COOC_2H_5$ 

Characteristics: oily

Formula Weight: 245.9

Boiling Point: 192 to 194°C. (at 760 mm.)

Specific Gravity: 1.903(20/20)

Refractive Index: 1.498

Solubility:

insoluble in water  $\infty$  (in alcohol) $\infty$  (in ether)ETHYL  $\alpha, \beta$ -DIBROMOBUTYRATE

Synonyms:

 $\alpha, \beta$ -dibromobutyric acid ethyl esterFormula:  $CH_3(CHBr)_2COOC_2H_5$ 

Formula Weight: 274.0

Boiling Point: 123 to 124°C. (at 30 mm.)

## ETHYL DIBUTYLCARBAMATE (N, N)

Formula:  $(C_4H_9)_2NCOOC_2H_5$ 

Formula Weight: 201.3

Boiling Point: 101 to 103°C. (at 6 mm.)

## ETHYL DICHLOROACETATE

Synonyms:

dichloroacetic acid ethyl ester

ethyl dichloroethanoate

Formula:  $CHCl_2COOC_2H_5$ 

Formula Weight: 157.0

Boiling Point:

158.2°C. (at 760 mm.)

156.5°C. (at 760 mm.)

Specific Gravity: 1.2821(20/4)

Refractive Index: 1.4386

Solubility:

insoluble in water  $\infty$  (in alcohol) $\infty$  (in ether)

## ETHYLDIETHANOLAMINE

Formula:  $C_2H_5N(CH_2CH_2OH)_2$ 

Characteristics:

pale yellow to pale orange

Formula Weight: 133.2

Freezing Point: -50°C.

Boiling Point: 240 to 270° C. (at 760 mm.)

Specific Gravity:

1.01 to 1.02(20/20)

8.5 lbs. per gal.

Refractive Index: 1.466

Flash Point: 255° F. (closed)

Solubility:

soluble in water, ether, methyl alcohol,  
acetone, benzene, ethyl acetone  
insoluble in gasoline

Additional Data:

coefficient of expansion,  
0.00080 per °C.

pH at 25° C.

Normality of aq. solution	pH
1.0 . . . . .	<u>11.36</u>
0.5 . . . . .	<u>11.21</u>
0.1 . . . . .	<u>10.88</u>
0.05 . . . . .	<u>10.69</u>
0.01 . . . . .	<u>10.33</u>
0.001 . . . . .	<u>9.75</u>

#### 9-ETHYL-9, 10-DIHYDROANTHRACENE

Synonyms:

9, 10-dihydro-9-ethylanthracene

Formula:  $C_6H_4:C_2H_3(C_2H_5):C_6H_4$

Characteristics: oily

Formula Weight: 208.3

Boiling Point:

320 to 323° C. (at 760 mm.)

slight decomposition

Specific Gravity: 1.049(18/18)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether  
∞ (in benzene)

#### ETHYL DIMETHYLACETOACETATE

Synonyms:

dimethylacetoacetic acid ethyl ester  
dimethylacetoacetic ester

Formula:  $CH_3COC(CH_3)_2COOC_2H_5$

Characteristics: oily

Formula Weight: 158.2

Boiling Point: 184 to 185° C. (at 760 mm.)

Specific Gravity: 0.977(20/20)

Solubility:

very slightly soluble in water  
soluble in alcohol    soluble in ether

#### ETHYL $\beta, \beta$ -DIMETHYLACRYLATE

Synonyms:

$\beta, \beta$ -dimethylacrylic acid ethyl ester

Formula:  $(CH_3)_2C:CHCOOC_2H_5$

Formula Weight: 128.2

Boiling Point: 154 to 155° C. (at 760 mm.)

Specific Gravity: 0.922(21/21)

Solubility:

very soluble in benzene, alcohol, ether,  
chloroform, carbon disulfide, and  
ligroin

#### ETHYLDIMETHYLAMINE

Synonyms: dimethylethylamine

Formula:  $(CH_3)_2NC_2H_5$

Formula Weight: 73.1

Boiling Point: 37.5° C. (at 760 mm.)

#### ETHYLDIPHENYLAMINE

Synonyms: N-ethyldiphenylamine

Formula:  $(C_6H_5)_2NC_2H_5$

Formula Weight: 197.3

Boiling Point:

295 to 297° C. (at 760 mm.)

286.0° C. (at 760 mm.)

Solubility:

insoluble in water    soluble in alcohol

#### ETHYLDIPHENYLPHOSPHINE

Formula:  $(C_6H_5)_2PC_2H_5$

Characteristics: oily

## ETHYLDIPHENYLPHOSPHINE (Cont.)

Formula Weight: 214.2

Boiling Point: 293° C. (at 760 mm.)

Solubility:

soluble in alcohol      soluble in benzene

## ETHYL ENANTHATE

Synonyms:

enantic acid ethyl ester	
cognac oil	ethyl heptoate
ethyl heptanoate	ethyl heptylate
oil of grapes	oenanthic ether
oleum vitis	oenanthylate
viniferae	

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{COOC}_2\text{H}_5$ 

Characteristics:

honey-coconut-like flavor  
 colorless to slightly yellow  
 highly disagreeable odor, resembling  
 brandy on dilution  
 soapy, burning sweet-taste

Formula Weight: 158.2

Melting Point: -66.1° C.

Boiling Point: 187 to 188° C. (at 760 mm.)

Specific Gravity:

0.872(20/20)      0.8685(20/4)

Refractive Index:

1.4130      1.4122

Uses:

synthetic cognac  
 numerous fruit flavors and essences

Solubility (grams per 100 ml.):

0.09 (in water) at 20° C.  
 very soluble in alcohol  
 $\infty$  (in ether)

## ETHYLENEDIAMINE

Synonyms:

1,2-diaminoethane    1,2-ethanediamine

Formula:  $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ 

Characteristics:

strong odor of ammonia  
 volatile

Formula Weight: 60.1

Melting Point: 8.5° C.

Boiling Point:

116.0 to 117.2° C. (at 760 mm.)

Specific Gravity:

0.900(20/20)      0.893(25/4)  
 0.8994(20/4)

7.5 lbs. per gal. at 20° C.

Refractive Index: 1.4540 at 26.1° C.

Viscosity (poises): 0.0154 at 25° C.

Flash Point:

110° F. (open)      93° C. (closed)

Heat of Vaporization (gram-calories per g.): 167 at 15° C.

Heat of Fusion (gram-calories per g.): 77 at 0° C.

Heat of Combustion (kilogram-calories per mole): 452.6 (liquid)

Uses:

textile lubricant  
 solvent for albumin and fibrin

Solubility (grams per 100 ml.):

water is very soluble in this compound  
 very soluble in water  
 0.3 (in ether)  
 $\infty$  (in alcohol)       $\infty$  (in benzene)

Additional Data:

highly hygroscopic  
 vapor density, 2.07  
 fumes in air  
 pH of 25° solution, 12.8 at 25° C.  
 dielectric constant, 16.0 at 18° C.  
 ionization constant,  $7.1 \times 10^{-5}$  at 25° C.  
 heat of solution,  
 7.6 cal./mole at 15° C.

## ETHYLENEDIAMINE HYDRATE

Formula:  $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2 \cdot \text{H}_2\text{O}$ 

Formula Weight: 78.1

Melting Point: 10° C.

Boiling Point: 118° C. (at 760 mm.)

Specific Gravity: 0.963(21/4)

Refractive Index: 1.4500

Solubility:  $\infty$  (in water)

#### ETHYLENE GLYCOL DIACETATE

Synonyms:

ethylene diacetate glycol diacetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OOCCH}_3$

Characteristics:

fruit-like odor like that of ethyl acetate

Formula Weight: 146.1

Freezing Point:  $-41.5^\circ\text{C}$ .

Boiling Point:  $190.5^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure (mm. Hg): 0.3 at  $20^\circ\text{C}$ .

Specific Gravity:

1.104 to 1.109(20/20)

9.206 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4159

Viscosity (centipoises): 2.86 at  $20^\circ\text{C}$ .

Flash Point: 220° F. (open)

Uses:

high-boiling, slow-evaporating solvent  
for cellulose ester printing inks and  
lacquers

solvent for camphor, cellulose acetate,  
cellulose nitrate, rosin, sandarac,  
and fluorinated refrigerants

partial solvent for cellulose ethers  
perfume fixative

solvent mixtures for refining lubricat-  
ing oils, and removal of free fatty  
acids from fats and oils

nondissolving plasticizer for benzyl  
and ethyl cellulose

Solubility (per cent by weight):

7.6 (of water) at  $20^\circ\text{C}$ .

16.4 (in water) at  $20^\circ\text{C}$ .

#### ETHYLENE GLYCOL DINITRATE

Synonyms:

ethylene nitrate glycol nitrate

Formula:  $\text{O}_2\text{NOCH}_2\text{CH}_2\text{ONO}_2$

Characteristics: yellow

Formula Weight: 152.1

Melting Point:  $-20^\circ\text{C}$ .

Boiling Point:

$114^\circ\text{C}$ . (at 760 mm.) explodes

Specific Gravity: 1.482(21/7)

Solubility:

insoluble in water

soluble in alcohol

decomposes in alkali

#### ETHYLENE GLYCOL DINITRITE

Synonyms:

ethylene nitrite glycol nitrite

Formula:  $\text{ONCH}_2\text{CH}_2\text{ONO}$

Formula Weight: 120.1

Melting Point:  $<-15^\circ\text{C}$ .

Boiling Point:  $96.8^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.216 at  $0^\circ\text{C}$ .

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

decomposes in alkali

#### ETHYLENE GLYCOL DIPROPIONATE

Synonyms:

ethylene dipropionate

glycol dipropionate

Formula:  $\text{C}_2\text{H}_5\text{COOCH}_2\text{CH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 174.2

Boiling Point: 211 to  $212^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.045 at  $25^\circ\text{C}$ .

Solubility:

slightly soluble in water

$\infty$  (in alcohol)  $\infty$  (in ether)

#### ETHYLENE MONOFORMATE

Synonyms:

ethylene monoformate

glycol monoformate

Formula:  $\text{HCOOCH}_2\text{CH}_2\text{OH}$

## ETHYLENE MONOFORMATE (Cont.)

Formula Weight: 90.1

Boiling Point: 180° C. (at 760 mm.)

Specific Gravity: 1.199(15/4)

## ETHYLENE OXIDE

## Synonyms:

1,2-epoxyethane      oxirane

## Characteristics:

agreeable odor      flammable  
volatile

Formula Weight: 44.1

Melting Point: -113.3° C.

## Boiling Point:

10.7° C. (at 760 mm.)

14° C. (at 760 mm.)

13.5° C. (at 747 mm.)

Specific Gravity: 0.887(7/4)

## Refractive Index:

1.35988 at 8.4° C.      1.3614 at 4° C.

## Surface Tension (dynes per cm.):

35.8 at -50° C.      24.3 at 20° C.

29.2 at -10° C.      (vapor)

## Inflammability Range (volume per cent in air):

3 (lower limit)      80 (upper limit)

Flash Point: &lt;0° F. (open)

Heat of Vaporization (gram-calories per g.): 139 at 15° C.

Heat of Combustion (kilogram-calories per mole): 302.1 (liquid)

## Uses:

fumigant      organic syntheses

## Solubility:

∞ (of water)      ∞ (in alcohol)

∞ (in water)      ∞ (in ether)

very soluble in benzene, and carbon tetrachloride

soluble in the usual organic solvents

## Additional Data:

autoignition temperature, 804° F.

vapor density, 1.52

## ETHYL ETHER

## Synonyms:

anesthesia ether      ethoxyethane  
diethyl ether      ethyl oxide  
diethyl oxide      sulfuric ether  
ether      vinic etherFormula: (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>O

## Characteristics:

highly mobile  
ethereal, distinct odor  
burning taste  
no foreign residual odor  
strongly narcotic

## Melting Point:

-116.3° C. (α)      -123.3° C. (β)

## Boiling Point:

34.4 to 34.6° C. (at 760 mm.)

## Specific Gravity:

0.708(25/4)      0.714(20/20)

0.7135(20/4)      0.7079(25/25)

0.7190(15/15)

6.0 lbs. per gal. at 20° C.

## Refractive Index:

1.3526      1.3497 at 24.8° C.

## Surface Tension (dynes per cm.):

17.0 at 20° C.      7.97 at 100° C.

13.5 at 50° C.

## Viscosity (centipoises):

1.69 at -100° C.      0.2332 at 20° C.

0.958 at -80° C.      0.23 at 25° C.

0.637 at -60° C.      0.223 at 30° C.

0.461 at -40° C.      0.197 at 40° C.

0.362 at -20° C.      0.166 at 60° C.

0.2842 at 0° C.      0.140 at 80° C.

0.118 at 100° C.

## Inflammability Range (volume per cent in air):

1.9 (lower limit)      48 (upper limit)

## Flash Point:

-40° F. (open)      -20° F. (closed)

## Specific Heat (gram-calories per g.):

0.5476 at 30° C. (liquid)

## Heat of Vaporization (gram-calories per g.):

83.9 at 15° C.

Heat of Combustion (kilogram-calories per mole): 651.7 (liquid)

Uses:

solvent for alkaloids, collodion, dyes, fats and oils, gums, nitrocellulose, perfumes, resins, smokeless powder, and waxes

cellulose nitrate rayon

gasoline engine primer

purification of chemicals

alcohol denaturant      laboratory reagent

anesthetic                  organic syntheses

collodion fabric          photographic films

cleaner                    pyroxylin products

intermediates            artificial silk

Solubility (grams per 100 ml.):

1.3 (of water) at 20° C.

7.5 (in water) at 20° C.

∞ (in alcohol)

∞ (in chloroform)

∞ (in benzene)

soluble in concentrated sulfuric acid, benzene, and oils

Additional Data:

hygroscopic

vapors are highly inflammable

oxidizes in air to ethyl peroxide

azeotrope with water boils at 34.14° C.,

has 98.74% by weight of ether coefficient of expansion,

0.000900 per ° F., 0.00164 per ° C.

weight of pure vapor, 3320 mg./l.

vapor density, 2.55

autoignition temperature, 366° F.

electrical conductivity,  $4 \times 10^{-13}$  mhos

critical temperature, 193.8° C.

critical pressure, 35.5 atm.

### ETHYL ETHOXYPROPIONATE

Synonyms:

ethoxypropionic acid ethyl ester

Formula:  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 146.0

Boiling Point: 165 to 172° C. (at 760 mm.)

Specific Gravity: 0.948(25/25)

Refractive Index: 1.4055 at 25° C.

Uses:

intermediate

organic syntheses

### ETHYL ETHYLACETOACETATE

Synonyms:

ethylacetoacetic acid ethyl ester

ethylacetoacetic ester

Formula:  $\text{CH}_3\text{COCH}(\text{C}_2\text{H}_5)\text{COOC}_2\text{H}_5$

Characteristics: oily

Formula Weight: 158.2

Boiling Point: 198.0° C. (at 760 mm.)

Specific Gravity: 0.986(20/4)

Solubility:

slightly soluble in water

∞ (in alcohol)                  ∞ (in ether)

### ETHYL ETHYLCARBAMATE

Synonyms: ethyl urethane

Formula:  $\text{C}_2\text{H}_5\text{NHCOOC}_2\text{H}_5$

Formula Weight: 117.2

Boiling Point: 174 to 176° C. (at 760 mm.)

Specific Gravity: 0.981(20/4)

Solubility (grams per 100 ml.):

63 (in water) at 15° C.

decomposes in hot alkali

### ETHYL ETHYLNITROSOCARBAMATE

Synonyms:

ethylnitrosocarbamic acid ethyl ester

N-nitroso-N-ethyl carbamate

nitroso-N-ethylurethan

Formula:  $\text{C}_2\text{H}_5\text{N}(\text{NO})\text{COOC}_2\text{H}_5$

Characteristics:

red

oily

Formula Weight: 146.2

Boiling Point: 86° C. (at 36 mm.)

Specific Gravity: 1.071(20/4)

## N-ETHYLFORMAMIDE

Synonyms: N-ethylmethanamide

Formula:  $\text{HCONHC}_2\text{H}_5$ 

Formula Weight: 73.1

Melting Point:  $< -30^\circ\text{C}$ .Boiling Point:  $197$  to  $199^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 0.952(21/4)

Solubility:

$\infty$ (in water)	$\infty$ (in alcohol)
	$\infty$ (in ether)

## ETHYL FORMATE

Synonyms:

ethyl methanoate  
formic acid ethyl ester  
formic ether  
methenyl

Formula:  $\text{HCOOC}_2\text{H}_5$ 

Characteristics:

pleasant aromatic odor, acetone odor  
when concentrated, rum odor diluted,  
diluted, non-residual odor  
volatile rum aroma  
bitter taste with a cooling effect

Formula Weight: 74.1

Melting Point:

$-79^\circ\text{C}$ .	$-80.5^\circ\text{C}$ .
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Boiling Point:

$54.3^\circ\text{C}$ . (at  $760$  mm.)  
 $53$  to  $57^\circ\text{C}$ . (at  $760$  mm.)  
 $51$  to  $55^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:

0.906(20/4)	0.900 to
0.9236(25/4)	<u>0.930(20/20)</u>
7.64 lbs. per gal. at $20^\circ\text{C}$ .	

Refractive Index:

1.35975	<u>1.3604</u>
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Surface Tension (dynes per cm.):

26.2 at $0^\circ\text{C}$ .	16.0 at $80^\circ\text{C}$ .
23.6 at $20^\circ\text{C}$ .	

Viscosity (centipoises):

0.5103 at $0^\circ\text{C}$ .	0.3356 at $40^\circ\text{C}$ .
0.402 at $20^\circ\text{C}$ .	0.3077 at $50^\circ\text{C}$ .

Inflammability Range (volume per cent in air):

3.5 (lower limit)	16.5 (upper limit)
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Flash Point:

9 to $10^\circ\text{F}$ . (open)	<u><math>-4^\circ\text{F}</math>. (closed)</u>
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Heat of Vaporization (gram-calories per g.):  $97.2$  at  $15^\circ\text{C}$ .Heat of Combustion (kilogram-calories per mole):  $391.7$  (liquid)

Uses:

fumigant	synthesis
larvicide	vitamin B <sub>1</sub>
acetone substitute	synthetic resins
artificial flavors and essences like rum	
solvent for cellulose acetate and nitrate	

Solubility:

$17\%$  by volume (of water) at  $20^\circ\text{C}$ .  
 $11$  grams per  $100$  ml. (in water)  
at  $18^\circ\text{C}$ .  
very soluble in alcohol  
very soluble in ether  
soluble in benzene

Additional Data:

electrical conductivity,  
 $1.45 \times 10^{-9}$  mhos at  $25^\circ\text{C}$ .  
vapor density,  $2.55$   
critical temperature,  $235.3^\circ\text{C}$ .  
critical pressure,  $46.8$  atm.  
unstable

## ETHYL FUMARATE

Synonyms:

diethyl fumarate  
fumaric acid diethyl ester  
fumaric acid ethyl ester

Formula:  $(\text{:CHCOOC}_2\text{H}_5)_2$ 

Formula Weight: 172.2

Melting Point:  $0.6^\circ\text{C}$ .Boiling Point:  $218.5^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.054(20/20)

**Solubility:**

slightly soluble in water  
soluble in alcohol      soluble in ether

**ETHYL  $\beta$ -FUROATE**

Synonyms:  $\beta$ -furoic acid ethyl ester

Formula:  $C_4H_3OCOOC_2H_5$

Formula Weight: 140.1

Boiling Point: 65 to 67°C. (at 14 mm.)

Specific Gravity: 1.038(20/20)

**ETHYL  $\alpha$ -FUROYLACETATE****Synonyms:**

2-furoylacetic acid ethyl ester  
ethyl pyromucylacetate

Formula:  $C_4H_3OCOCH_2COOC_2H_5$

**Characteristics:**

pale yellow      oily

Formula Weight: 182.2

Boiling Point: 142 to 145°C. (at 10 mm.)

Specific Gravity: 1.165 at 17°C.

**Solubility:**

insoluble in water  
soluble in alcohol      soluble in ether  
very soluble in ammonium hydroxide

**ETHYL FURYLACRYLATE****Synonyms:**

furylacrylic acid ethyl ester

Formula:  $C_4H_3OCH:CHCOOC_2H_5$

Formula Weight: 166.2

Melting Point: 24.5°C.

Boiling Point: 132 to 133°C. (at 18 mm.)

Refractive Index: 1.5286

**Uses:**

synthetic coffee flavor  
maple and walnut component

**Solubility:**

insoluble in water      soluble in alcohol

**ETHYL GLUTACONATE**

Synonyms: glutaconic acid ethyl ester

Formula:  $C_3H_4(COOC_2H_5)_2$

Formula Weight: 186.2

Boiling Point: 236 to 238°C. (at 760 mm.)

Specific Gravity: 1.050(20/4)

**Solubility:**

insoluble in water      soluble in alcohol  
soluble in ether

**ETHYL GLUTARATE****Synonyms:**

diethyl pentanedioate  
diethyl glutarate  
glutaric acid ethyl ester  
glutaric acid diethyl ester

Formula:  $C_2H_5OOC(CH_2)_3COOC_2H_5$

Characteristics: syrupy

Formula Weight: 188.2

Melting Point: -24.1°C.

Boiling Point: 237.0°C. (at 760 mm.)

Specific Gravity: 1.025(20/4)

Refractive Index: 1.4241

Solubility (grams per 100 ml.):

0.88 (in water) at 20°C.  
very soluble in alcohol  
soluble in ether

**ETHYL GLYCERATE****Synonyms:**

ethyl 2,3-dihydroxypropanoate  
glyceric acid ethyl ester

Formula:  $CH_2OHCHOHCOOC_2H_5$

Formula Weight: 134.1

Boiling Point:

121°C. (at 14 mm.)  
230 to 240°C. (at 760 mm.)

Specific Gravity: 1.191(15/15)

**Solubility:**

soluble in water      soluble in alcohol  
very soluble in ether

## ETHYL GLYCINATE

## Synonyms:

ethyl aminoethanoate  
glycine ethyl ester

Formula:  $\text{NH}_2\text{CH}_2\text{COOC}_2\text{H}_5$

Characteristics: oily

Formula Weight: 103.1

Melting Point:  $< -20^\circ\text{C}$ .

Boiling Point:

$148^\circ\text{C}$ . (at 748 mm.)  
slight decomposition

Specific Gravity: 1.028(20/4)

Solubility:

$\infty$  (in water)                       $\infty$  (in alcohol)  
    $\infty$  (in ether)

## ETHYL GLYCOLATE

## Synonyms:

ethyl hydroxyethanoate  
glycolic acid ethyl ester

Formula:  $\text{CH}_2\text{OHCOOC}_2\text{H}_5$

Formula Weight: 104.1

Boiling Point:

$160^\circ\text{C}$ . (at 760 mm.)  
 $158.2^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.087(15/4)                      1.0826(25/4)

Solubility:

very soluble in alcohol  
very soluble in ether

## ETHYL HENDECYLATE

## Synonyms:

ethyl undecylate  
hendecanoic acid ethyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{COOC}_2\text{H}_5$

Formula Weight: 214.3

Boiling Point:  $140^\circ\text{C}$ . (at 20 mm.)

Solubility: insoluble in water

## 4-ETHYLHEPTANE

## Synonyms:

ethyldipropylmethane  
nonane

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{C}_2\text{H}_5)(\text{CH}_2)_2\text{CH}_3$

Formula Weight: 128.3

Boiling Point:  $139^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.741(20/4)

Refractive Index: 1.408

Uses: organic syntheses

Solubility:

insoluble in water    soluble in ether  
insoluble in alcohol

## 4-ETHYL-4-HEPTANOL

## Synonyms:

ethyldipropylcarbinol  
ethyldipropylmethanol  
nonyl alcohol

Formula:  $\text{C}_2\text{H}_5\text{COH}(\text{CH}_2\text{CH}_2\text{CH}_3)_2$

Formula Weight: 144.3

Boiling Point:  $179.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8349(20/4)

Solubility:

insoluble in water    soluble in alcohol  
   soluble in ether

## 3-ETHYLHEXANE

## Synonyms:

diethylpropylmethane  
octane

Formula:  $(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 114.2

Boiling Point:  $118.9^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.7169(20/4)

Refractive Index: 1.4016

Heat of Combustion (kilogram-calories  
per mole): 1302.3 (liquid)

**Solubility:**

insoluble in water  
slightly soluble in alcohol  
soluble in ether

**2-ETHYL-1,3-HEXANEDIOL****Synonyms:**

ethylhexanediol  
ethylhexylene glycol  
Insect Repellent "6-12 Formula"

**Formula:**

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHOHCH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OH}$$
**Characteristics:**

faint odor similar to witch hazel

**Formula Weight:** 146.2

**Freezing Point:** < -40° C.

**Boiling Point:**

244.2° C. (at 760 mm.)  
240 to 250° C. (at 760 mm.)

**Vapor Pressure (mm. Hg):**

< 0.01 at 20° C.

**Specific Gravity:**

0.9422(20/20)  
7.84 lbs. per gal. at 20° C.

**Refractive Index:** 1.4511

**Viscosity (centipoises):** 323 at 20° C.

**Flash Point:** 260° F. (open)

**Uses:** insect repellent

**Solubility (grams per 100 ml.):**

11.7 (of water) at 20° C.  
4.2 (in water) at 20° C.

**2-ETHYL-1-HEXANOL****Synonyms:**

ethylhexanol  
2-ethylhexyl alcohol  
octanol  
octyl alcohol

**Formula:**  $\text{C}_4\text{H}_9\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OH}$

**Formula Weight:** 130.2

**Melting Point:** < -76° C.

**Boiling Point:**

183.5° C. (at 760 mm.)  
182 to 201° C. (at 760 mm.)

**Vapor Pressure (mm. Hg):**

0.3 at 20° C.      1 at 30° C.

**Specific Gravity:**

0.8340(20/20)  
6.9 lbs. per gal. at 20° C.

**Refractive Index:** 1.4300

**Surface Tension (dynes per cm.):**

30 at 22° C.

**Viscosity (poises):** 0.0705 at 25° C.

**Flash Point:** 185° F. (open)

**Specific Heat (gram-calories per g. per ° C.):** 0.564 at 25° C. (liquid)

**Heat of Vaporization (gram-calories per g.):** 92.8 at the boiling point

**Uses:**

increases the solvent power of true solvents for nitrocellulose lacquers      defoaming dispersing, wetting agent solvent for gums, oils, resins, lacquers and waxes

**Solubility (grams per 100 ml.):**

2.57 (of water) at 20° C.  
0.10 (in water) at 20° C.  
soluble in alcohol      soluble in ether  
miscible with most organic solvents

**Additional Data:**

coefficient of expansion,  
0.000902 to 50° C.,  
0.00088 at 10 to 30° C.  
azeotropic mixture with water boils at 99.1° C. and contains 20% of alcohol

**3-ETHYL-3-HEXANOL****Synonyms:**

diethylpropylcarbinol  
diethylpropylmethanol  
octyl alcohol

**Formula:**  $\text{C}_2\text{H}_5\text{COH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2\text{CH}_3$

**Formula Weight:** 130.2

**Boiling Point:** 160.5° C. (at 760 mm.)

## 3-ETHYL-3-HEXANOL (Cont.)

Specific Gravity:

0.8379(20/20)      0.838(20/4)

Refractive Index: 1.433

Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

## 2-ETHYL-2-HEXENAL

Synonyms: 2-ethyl-3-propylacrolein

Formula:  $C_3H_7CH:C(C_2H_5)CHO$ 

Characteristics:

very strong odor      yellow

Formula Weight: 126.2

Boiling Point: 175.0° C. (at 760 mm.)

Specific Gravity:

0.848(20/4)      0.8518(20/20)  
7.07 lbs. per gal. at 20° C.

Flash Point: 155° F. (open)

Uses:

organic syntheses      warning agents  
 insecticides      leak detector

Solubility (grams per 100 ml.):

0.65 (of water) at 20° C.0.07 (in water) at 20° C.

miscible with the usual organic  
 solvents

## 3-ETHYL-2-HEXENE

Synonyms: octylene

Formula:  $CH_3CH:C(C_2H_5)CH_2C_2H_5$ 

Formula Weight: 112.2

Boiling Point: 119.4° C. (at 760 mm.)

Specific Gravity: 0.736(20/0)

Solubility: insoluble in water

## 2-ETHYLHEXYL ACETATE

Synonyms:

2-ethyl-1-hexanol acetate  
 β-ethylhexyl acetate  
 octyl acetate

Formula:  $CH_3COOCH_2CH(C_2H_5)C_4H_9$ 

Formula Weight: 172.3

Melting Point: -93° C.

Boiling Point:

199° C. (at 760 mm.)  
 192 to 202° C. (at 760 mm.)  
198.6° C. (at 760 mm.)

Vapor Pressure (mm. Hg):

0.4 at 20° C.      1 at 30° C.

Specific Gravity:

0.872  
7.27 lbs. per gal. at 20° C.

Refractive Index:

1.420      1.430 at 20° C.

Flash Point: 190° F. (open)

Uses:

good solvent for nitrocellulose and  
 resins  
 baking finishes      lacquers

Solubility (grams per 100 ml.):

0.55 at 20° C. (of water)less than 0.03 at 20° C.

0.01 at 43° C. (in water)

Additional Data:

coefficient of expansion,

0.00099 at 10 to 30° C.

dilution ratio,

with xylene . . . . . 1.4with mineral spirits. . . . . 1.0

## 2-ETHYL-1-HEXYLAMINE

Synonyms:

2-ethyl-1-aminoheptane  
 octylamine

Formula:  $C_4H_9(C_2H_5OH)CH_2NH_2$ 

Formula Weight: 129.2

Boiling Point: 167 to 168° C. (at 760 mm.)

Specific Gravity: 0.792(20/20)

## ETHYLHEXYL "CELLOSOLVE"

Formula:  $C_4H_9CH(C_2H_5)CH_2OCH_2CH_2OH$ 

Formula Weight: 174.3

Boiling Point: 228.3° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.02 at 20° C.

Specific Gravity:

0.8859(20/20)

7.4 lbs. per gal. at 20° C.

Flash Point: 230° F. (open)

Uses:

high boiling solvent for nitrocellulose,  
cellulose ether lacquers

Solubility (grams per 100 ml.):

5.4 at 20° C. (of water)

0.09 at 20° C. ( in water)

#### ETHYL HEXYL ETHER

Synonyms: 1-ethoxyhexane

Formula:  $C_2H_5O(CH_2)_5CH_3$

Formula Weight: 130.2

Boiling Point: 137° C. (at 760 mm.)

Specific Gravity: 0.8327(0/4)

Solubility:

insoluble in water

very soluble in alcohol, and ether

#### 2-ETHYLHEXYL VINYL ETHER

Synonyms: vinyl 2-ethylhexyl ether

Formula:  $CH_2:CHOCH_2CH(C_2H_5)C_4H_9$

Formula Weight: 156.3

Boiling Point:

182° C. (at 760 mm.)

61 to 63° C. (at 10 mm.)

Specific Gravity:

0.810(20/15.6)

6.75 lbs. per gal.

Refractive Index: 1.4232 at 30° C.

Uses: organic syntheses

#### ETHYL HYDRACRYLATE

Synonyms:

hydracrylic acid ethyl ester

Formula:  $CH_2OHCH_2COOC_2H_5$

Formula Weight: 128.15

Boiling Point: 185 to 190° C. (at 760 mm.)

Specific Gravity: 1.064 at 25° C.

Solubility:

miscible with water, alcohol, and  
ether

#### ETHYLHYDRAZINE

Formula:  $C_2H_5NHNH_2$

Formula Weight: 60.1

Boiling Point:

101.5° C. (at 760 mm.)

99.5° C. (at 709 mm.)

Solubility:

very soluble in water, alcohol, and  
ether

Additional Data: hygroscopic

#### ETHYL HYDROCINNAMATE

Synonyms:

ethyl benzenepropanoate

ethyl  $\beta$ -phenylpropionate

hydrocinnamic acid ethyl ester

Formula:  $C_6H_5CH_2CH_2COOC_2H_5$

Formula Weight: 178.2

Boiling Point: 249° C. (at 760 mm.)

Specific Gravity: 1.015(20/4)

Refractive Index: 1.49542

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

#### ETHYL HYDROGEN OXALATE

Synonyms: ethyloxalic acid

Formula:  $HOCCOOC_2H_5$

Formula Weight: 118.1

Boiling Point: 117° C. (at 15 mm.)

Specific Gravity: 1.218(20/4)

## ETHYL HYDROGEN PHTHALATE

Formula:  $\text{C}_6\text{H}_4(\text{COOC}_2\text{H}_5)\text{COOH}$ 

Characteristics: oily

Formula Weight: 194.2

Melting Point:  $20^\circ\text{C}$ .

Boiling Point: decomposes

Solubility:

slightly soluble in water  
soluble in alcohol and ether

## ETHYL HYDROGEN SULFATE

Synonyms: ethylsulfuric acid

Formula:  $\text{C}_2\text{H}_5\text{OSO}_2\text{OH}$ 

Characteristics: syrupy

Formula Weight: 126.1

Boiling Point: decomposes

Specific Gravity: 1.316 at  $17^\circ\text{C}$ .

Solubility:

$\infty$  (in water)                       $\infty$  (in alcohol)  
    $\infty$  (in ether)  
decomposes in hot water  
decomposes in hot alcohol

## ETHYL HYDROSELENIDE

Formula:  $\text{C}_2\text{H}_5\text{SeH}$ 

Formula Weight: 109.1

Boiling Point:  $53.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.395(24/4)

Solubility: insoluble in water

## ETHYL HYDROXYETHYL ETHER

Synonyms: ethyl glycol ether

Formula:  $\text{CH}_2\text{OHCH}_2\text{OC}_2\text{H}_5$ 

Formula Weight: 90.1

Boiling Point: 134 to  $135^\circ\text{C}$ . (at 748 mm.)

Specific Gravity: 0.935(15/15)

ETHYL *d*-HYDROXYISOBUTYRATE

Synonyms:

ethyl oxybutyrate

*d*-hydroxyisobutyric acid ethyl esterFormula:  $(\text{CH}_3)_2\text{COHCOOC}_2\text{H}_5$ 

Formula Weight: 132.2

Boiling Point:

149 to  $150^\circ\text{C}$ . (at 760 mm.)144 to  $146^\circ\text{C}$ . (at 760 mm.)137.8 to  $147.0^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.970(25/25)

0.978 to 0.986 at  $20^\circ\text{C}$ .8.18 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4066

Uses:

organic syntheses

solvent for cellulose acetate and  
nitrocellulose

solvent mixtures for cellulose ethers

Solubility:

decomposes in hot water

very soluble in water

miscible with most organic solvents

Additional Data:

ester value, 96 to 100%

ETHYL *d*-HYDROXYLAMINE

Synonyms: ethoxyamine

Formula:  $\text{C}_2\text{H}_5\text{ONH}_2$ 

Formula Weight: 61.1

Boiling Point:  $68^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 0.883 at  $7.5^\circ\text{C}$ .

Solubility:

miscible with water, alcohol, and ether

## ETHYL HYPOCHLORITE

Formula:  $\text{C}_2\text{H}_5\text{OCl}$ 

Characteristics: yellow

Formula Weight: 80.5

Boiling Point:  $36^\circ\text{C}$ . (at 752 mm.)

## Solubility:

miscible with ether, chloroform, and benzene

## ETHYL IODOACETATE

Synonyms: ethyl iodoethanoate

Formula:  $\text{CH}_2\text{ICOOC}_2\text{H}_5$

Characteristics: oily

Formula Weight: 214.0

Boiling Point:

178 to 180°C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.54 at 20°C.

Specific Gravity: 1.817(12.7/4)

Uses: organic syntheses

Solubility:

decomposed by water and alkalies

Additional Data:

vapor density, 7.4

very irritating to the eyes

decomposed by air and light

## ETHYL ISOAMYL ETHER

Synonyms: 1-ethoxy-3-methylbutane

Formula:  $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 116.2

Boiling Point: 112°C. (at 760 mm.)

Specific Gravity: 0.764(18/4)

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## ETHYL ISOBUTYL ETHER

Synonyms: 1-ethoxy-2-methylpropane

Formula:  $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 102.2

Boiling Point: 78 to 80°C. (at 760 mm.)

Specific Gravity: 0.751(20/4)

Heat of Vaporization (gram-calories per g.): 74.8 at 15°C.

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## ETHYL ISOBUTYRATE

Synonyms:

ethyl 2-methylpropanoate

isobutyric acid ethyl ester

isobutyric ether

Formula:  $(\text{CH}_3)_2\text{CHCOOC}_2\text{H}_5$

Characteristics:

fruity odor                      volatile

Formula Weight: 116.2

Melting Point: -88.2°C.

Boiling Point: 111.7°C. (at 760 mm.)

Specific Gravity:

0.8693(20/4)                      0.870(20/20)

Refractive Index: 1.3903

Surface Tension (dynes per cm.):

24.8 at 5°C.                      13.85 at 110°C.  
 23.25 at 20°C.

Heat of Vaporization (gram-calories per g.): 72.1 at 15°C.

Heat of Combustion (kilogram-calories per mole): 845.7 (liquid)

Uses:

flavoring essences    organic syntheses

Solubility:

slightly soluble in water  
 $\infty$  (in ether)                       $\infty$  (in alcohol)

Additional Data: inflammable

## ETHYL ISOCYANATE

Synonyms: isocyanic acid ethyl ester

Formula:  $\text{C}_2\text{H}_5\text{NCO}$

Formula Weight: 71.1

Boiling Point: 60.0°C. (at 760 mm.)

Specific Gravity: 0.898(20/4)

## ETHYL ISOCYANATE (Cont.)

Heat of Combustion (kilogram-calories per mole): 424.5 (liquid)

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## ETHYL ISOCYANIDE

Synonyms: ethyl carbylamine

Formula:  $C_2H_5NC$

Formula Weight: 55.1

Melting Point:  $< -66^\circ C$ .

Boiling Point:  $78$  to  $79^\circ C$ . (at  $760$  mm.)

## Specific Gravity:

$0.744$  at  $25^\circ C$ .             $0.7402(20/4)$

Refractive Index:  $1.3659$  at  $24^\circ C$ .

## Solubility:

soluble in water             $\infty$  (in alcohol)  
 very soluble in ether

## ETHYL ISOPROPYLACETOACETATE

## Synonyms:

isopropylacetoacetic acid ethyl ester

Formula:  $CH_3COCH(C_3H_7)COOC_2H_5$

Formula Weight:  $172.2$

## Boiling Point:

$205^\circ C$ . with decomposition

Specific Gravity:  $0.960(25/25)$

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)             $\infty$  (in ether)

## ETHYL ISOPROPYL ETHER

Synonyms: 2-ethoxypropane

Formula:  $C_2H_5OCH(CH_3)_2$

Formula Weight:  $88.2$

Boiling Point:  $54^\circ C$ . (at  $760$  mm.)

Specific Gravity:  $0.745(0/4)$

## Solubility:

soluble in water             $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## ETHYL ISOSUCCINATE

## Synonyms:

diethyl isosuccinate  
 isosuccinic acid diethyl ester  
 isosuccinic acid ethyl ester

Formula:  $CH_3CH(COOC_2H_5)_2$

Formula Weight:  $174.2$

## Boiling Point:

$201.2$  to  $201.4^\circ C$ . (at  $760$  mm.)

Specific Gravity:  $1.021(15/15)$

## Solubility:

insoluble in water             $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## ETHYL ISOTHIOCYANATE

## Synonyms:

ethyl mustard oil  
 isothiocyanic acid ethyl ester

Formula:  $C_2H_5NCS$

## Characteristics:

colorless to yellow, pungent odor

Formula Weight:  $87.1$

Melting Point:  $-5.9^\circ C$ .

Boiling Point:  $130$  to  $132^\circ C$ . (at  $760$  mm)

## Specific Gravity:

$1.004(15/4)$              $0.995(20/4)$

Refractive Index:  $1.5134$

## Solubility:

insoluble in water  
 soluble in alcohol and ether

## ETHYL ISOVALERATE

## Synonyms:

isovaleric acid ethyl ester

Formula:  $(CH_3)_2CHCH_2COOC_2H_5$

Characteristics:  
oily                               sour sweet taste  
apple odor                       apple flavor

Formula Weight: 130.2

Melting Point: -99.3° C.

Boiling Point:  
134.3° C. (at 760 mm.)  
135° C. (at 760 mm.)

Specific Gravity:  
0.8657(20/4)                   0.868(20/20)

Refractive Index:  
1.3967 at 18° C.           1.4009 at 20° C.

Uses:  
antispasmodic, and sedative  
beverage and confectionery flavor

Solubility (grams per 100 ml.):  
0.17 at 20° C.               ∞ (in ether)  
∞ (in alcohol)               ∞ (in benzene)

ETHYL ITACONATE

Synonyms:  
diethyl itaconate  
itaconic acid ethyl ester

Formula: C<sub>3</sub>H<sub>4</sub>(COOC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>

Formula Weight: 186.2

Boiling Point: 228 to 229° C. (at 760 mm.)

Specific Gravity: 1.050(15/15)

ETHYL LACTATE

Synonyms:  
ethyl 2-hydroxypropanoate  
ethyl 2-hydroxypropionate  
lactic acid ethyl ester

Formula: CH<sub>3</sub>CHOHCOOC<sub>2</sub>H<sub>5</sub>

Characteristics:  
nonresidual, mild characteristic odor  
oily

Formula Weight: 118.1

Melting Point: -25° C.

Boiling Point:  
150 to 155° C. (at 760 mm.)  
102 to 173° C. (at 760 mm.)  
119 to 176° C. (at 760 mm.)

Specific Gravity:  
1.031(20/4)                   1.020 to  
1.030(25/4)                   1.036(20/20)  
8.56 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg): 5 at 30° C.

Refractive Index: 1.4125

Surface Tension (dynes per cm.):  
29.9 at 20° C.

Viscosity (centipoises):  
195 (10% 1/2 sec. RS nitrocellulose  
solution)

Flash Point:  
115° F. (closed)           145° F. (open)

Uses:  
solvent for cellulose acetate, aceto-  
butyrate, acetopropionate and ethers,  
nitrocellulose, gums, and resins  
dopes                               inks  
lacquers, varnishes, paints, and  
enamels  
safety glass                       stencil sheets

Solubility:  
∞ (of water)                   ∞ (in water)  
very soluble in alcohol and ether  
miscible with alcohols, ketones, esters,  
and hydrocarbon oils

Additional Data:  
vapor density, 4.41  
coefficient of expansion (room  
temperature),  
0.000544 per ° F.   0.00098 per ° C.  
dilution ratio,  
with toluene . . . . . 6.3  
with petroleum naphtha . . . . 0.7  
dilution ratio (nitrocellulose solution  
method),  
with toluene . . . . . 5.3  
with petroleum naphtha . . . . 0.8

## ETHYL LACTATE (Cont.)

Blush Resistance  
(10% 1/2 sec. RS nitrocellulose solution)

	Clear	Blush
Relative humidity	80%	85%

Evaporation Rate at 95° F.

%	Minutes
5 . . . .	4
25 . . . .	23
50 . . . .	47 3/4
75 . . . .	73
90 . . . .	92 3/4
95 . . . .	101

## ETHYL LAURATE

Synonyms:

ethyl dodecanoate  
lauric acid ethyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{COOC}_2\text{H}_5$

Characteristics:

oily  
flowery odor recalling tuberose  
sweet, somewhat soapy aftertaste

Formula Weight: 228.4

Melting Point:

-10.7° C.                      -1.68° C.

Boiling Point:

269° C. (at 760 mm.)  
163° C. (at 25 mm.)

Specific Gravity: 0.8615(20/4)

Refractive Index: 1.4321

Uses: coconut flavors

Solubility:

insoluble in water  
very soluble in alcohol  
 $\infty$  (in ether)

## ETHYL LEVULINATE

Synonyms: levulinic acid ethyl ester

Formula:  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 144.2

Boiling Point:

205 to 206.2° C. (at 760 mm.)  
205.2° C. (at 756 mm.)

Specific Gravity:

1.01346(20/4)                      1.016(20/20)

Uses:

solvent for cellulose acetate and  
starch ethers

Solubility:

very soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## ETHYL LINOLEATE

Synonyms:

ethyl linolate  
linoleic acid ethyl ester

Formula:  $\text{C}_{17}\text{H}_{31}\text{COOC}_2\text{H}_5$

Characteristics:

colorless to yellow oily

Formula Weight: 308.5

Boiling Point: 270 to 275° C. (at 180 mm)

Specific Gravity: 0.8865(20) at 20° C.

Solubility:

insoluble in water  
soluble in alcohol and ether

## ETHYL LINOLENATE

Synonyms:

linolenic acid ethyl ester

Formula:  $\text{C}_{17}\text{H}_{29}\text{COOC}_2\text{H}_5$

Characteristics: oily

Formula Weight: 306.5

Boiling Point: 230 to 232° C. (at 17 mm)

Specific Gravity: 0.905(20/4)

Solubility:

insoluble in water                       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ETHYL MALATE

## Synonyms:

diethyl malate  
diethyl hydroxybutanedioate  
malic acid (di-) ethyl ester

Formula:  $\text{CH}_2(\text{COOC}_2\text{H}_5)\text{CHOHCOOC}_2\text{H}_5$

Formula Weight: 190.2

Boiling Point: 253 to 255°C. (at 760 mm.)

## Specific Gravity:

1.128                      1.124(21/4)

Refractive Index: 1.4362

Viscosity (centipoises): 3.106 at 24.7°C.

## Solubility:

soluble in water             $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

## ETHYL MALEATE

## Synonyms:

diethyl maleate  
maleic acid (di-) ethyl ester

Formula:  $\text{C}_2\text{H}_5\text{OOCCH:CHCOOC}_2\text{H}_5$

Formula Weight: 172.2

## Boiling Point:

225°C. (at 760 mm.)  
105 to 106°C. (at 14 mm.)

## Specific Gravity:

1.070(20/20)              1.064 at 25.2°C.

## Solubility:

insoluble in water  
soluble in alcohol and ether

## ETHYL MALONATE

## Synonyms:

diethyl malonate  
diethyl propanedioate  
malonic acid (di-) ethyl ester  
malonic ester

Formula:  $\text{CH}_2(\text{COOC}_2\text{H}_5)_2$

## Characteristics:

sweet odor  
agreeable aromatic apple fruity odor  
weak sour taste          apple flavor

Formula Weight: 160.2

Melting Point: -49.8°C.

## Boiling Point:

198.9°C. (at 760 mm.)  
198 to 199°C. (at 760 mm.)  
94 to 96°C. (at 18 mm.)

## Specific Gravity:

1.055(20/4)              1.076 at 0°C.

Refractive Index: 1.4143

Heat of Combustion (kilogram-calories  
per mole): 860.4 (liquid)

## Uses:

intermediate  
apple and pear flavors

## Solubility (grams per 100 ml.):

2.08 at 20°C. (in water)  
 $\infty$  (in alcohol)           $\infty$  (in ether)  
soluble in chloroform and benzene

## ETHYL MERCAPTOACETATE

## Synonyms:

ethyl thioglycolate  
mercaptoacetic acid ethyl ester  
2-mercaptoethanoic acid ethyl ester  
thioglycolic acid ethyl ester

Formula:  $\text{HSCH}_2\text{COOC}_2\text{H}_5$

Formula Weight: 120.2

Boiling Point: 156 to 158°C. (at 760 mm.)

Specific Gravity: 1.096 at 15°C.

Solubility: insoluble in water

## ETHYL MERCAPTOACETIC ACID

## Synonyms:

ethyl 2-mercaptoethanoic acid  
ethylthioglycolic acid

Formula:  $\text{C}_2\text{H}_5\text{SCH}_2\text{COOH}$

Characteristics: oily

Formula Weight: 120.2

Melting Point: -8.7°C.

Boiling Point: 123 to 124°C. (at 15 mm.)

## ETHYL MERCAPTOACETIC ACID (Cont.)

Specific Gravity: 1.150(20/4)

Solubility:

 $\infty$  (in water)

soluble in alcohol and ether

## ETHYL MESACONATE

Synonyms:

diethyl mesaconate

mesaconic acid (di-) ethyl ester

Formula:  $\text{CH}_3\text{C}_2\text{H}(\text{COOC}_2\text{H}_5)_2$ 

Formula Weight: 186.2

Boiling Point: 229° C. (at 760 mm.)

Specific Gravity: 1.047(20/4)

## ETHYL MESOXALATE

Synonyms:

(di-) ethyl ketomalonate

diethyl mesoxalate

(di-) ethyl oxopropanedioate

mesoxalic acid (di-) ethyl ester

Formula:  $\text{CO}(\text{COOC}_2\text{H}_5)_2$ 

Characteristics:

yellow green                      oily

Formula Weight: 174.2

Melting Point: -30° C.

Boiling Point:

220° C. (at 760 mm.)

115° C. (at 29 mm.)

Specific Gravity: 1.119(20/20)

Refractive Index: 1.4187 at 15.6° C.

Solubility:

soluble in alcohol and ether

## ETHYL METHACRYLATE

Synonyms:

ethyl methyl acrylate

methacrylic acid ethyl ester

Formula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{COOC}_2\text{H}_5$ 

Formula Weight: 114.1

Melting Point: -78° C.

Boiling Point:

115 to 120° C. (at 760 mm.)

117 to 118° C. (at 760 mm.)

Specific Gravity:

0.907(20/4)

0.910 at 25° C.

7.55 lbs. per gal.

Refractive Index: 1.414

Flash Point: 68° F. (open)

Uses: organic syntheses

Solubility:

insoluble in water

very soluble in alcohol and ether

Additional Data:

the commercial product contains an inhibitor

## ETHYL METHYLACETOACETATE

Synonyms:

ethyl 2-methyl-3-oxobutanoate

methylacetoacetic acid ethyl ester

methylacetoacetic ester

Formula:  $\text{CH}_3\text{COCH}(\text{CH}_3)\text{COOC}_2\text{H}_5$ 

Formula Weight: 144.2

Boiling Point: 186.8° C. (at 760 mm.)

Specific Gravity: 1.019(20/4)

Refractive Index: 1.4207 at 17.8° C.

Solubility:

insoluble in water

soluble in alcohol and ether

## ETHYLMETHYLAMINE

Synonyms: methylethylamine

Formula:  $\text{CH}_3\text{NHC}_2\text{H}_5$ 

Formula Weight: 59.1

Boiling Point: 34 to 35° C. (at 760 mm.)

## ETHYLMETHYLANILINE

Synonyms: methylethylaniline

Formula:  $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)\text{C}_2\text{H}_5$

Formula Weight: 135.2

Boiling Point: 201° C. (at 760 mm.)

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

#### ETHYL 2-METHYLBUTYL ETHER

Synonyms:

act-amyl ethyl ether  
ethyl act-amyl ether

Formula:  $C_2H_5OC_5H_{11}$

Formula Weight: 116.2

Boiling Point: 108 to 109° C. (at 736 mm.)

Specific Gravity: 0.759(18/4)

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

#### ETHYL METHYL CARBONATE

Synonyms:

carbonic acid ethyl methyl ester  
methyl ethyl carbonate

Formula:  $CH_3OCOOC_2H_5$

Formula Weight: 104.1

Melting Point: -14.5° C.

Boiling Point: 109.2° C. (at 760 mm.)

Specific Gravity: 1.002 at 27° C.

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

#### ETHYL METHYL ETHER

Synonyms:

methoxyethane            methyl ether ether

Formula:  $CH_3OC_2H_5$

Formula Weight: 60.1

Boiling Point:

7.9 to 12° C. (at 760 mm.)  
10.8° C. (at 760 mm.)

Specific Gravity: 0.7260(0/4)

Inflammability Range (volume per cent in air):

2.0 (lower limit)      10.1 (upper limit)

Flash Point: -35° F. (closed)

Solubility:

soluble in water      ∞ (in alcohol)  
                                 ∞ (in ether)

Additional Data:

vapor density, 2.07  
critical temperature, 164° C.  
critical pressure, 43.4 atm.  
autoignition temperature, 374° F.

#### 7-ETHYL-2-METHYL-4-HENDECANOL

Synonyms:

7-ethyl-2-methylundecanol-4  
tetradecanol

Formula:

$C_4H_9CH(C_2H_5)C_2H_4CHOHCH_2CH(CH_3)_2$

Characteristics: mild odor

Formula Weight: 214.4

Boiling Point: 264.1° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.01 at 20° C.

Specific Gravity:

0.8355(20/20)  
6.95 lbs. per gal. at 20° C.

Flash Point: 285° F. (open)

Uses:

antifoaming agent  
organic synthesis of cosmetic ingredients, detergents, dyes, insecticides, plastics, and wetting agents

Solubility (grams per 100 ml.):

0.66 at 20° C. (of water)  
less than 0.02 at 20° C. (in water)

Additional Data:

does not turn rancid on oxidation or polymerization

#### 5-ETHYL-2-METHYL-5-HEPTENE

Synonyms:

decylene  
2-methyl-5-ethyl-5-heptene

## 5-ETHYL-2-METHYL-5-HEPTENE

(Cont.)

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{C}(\text{C}_2\text{H}_5)\text{CHCH}_3$ 

Formula Weight: 140.3

Boiling Point: 157 to 158°C. (at 750 mm.)

Specific Gravity: 0.752(11/4)

Solubility: insoluble in water

## 3-ETHYL-5-METHYL-3-HEXANOL

Synonyms:

diethylisobutylcarbinol

diethylisobutylmethanol

4-ethyl-2-methyl-4-hexanol

nonyl alcohol

Formula:  $(\text{C}_2\text{H}_5)_2\text{COHCH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 144.3

Boiling Point: 172°C. (at 760 mm.)

Specific Gravity: 0.8396(22/4)

Solubility:

insoluble in water

soluble in alcohol and ether

## ETHYL METHYLNITROSOCARBAMATE

Synonyms:

methylnitrosocarbamic acid ethyl ester

nitroso-N-methylurethane

Formula:  $\text{CH}_3\text{N}(\text{NO})\text{COOC}_2\text{H}_5$ 

Characteristics: yellow red

Formula Weight: 132.1

Melting Point: &lt; -20°C.

Boiling Point: 65°C. (at 13 mm.)

Specific Gravity: 1.122(20/4)

Solubility:

slightly soluble in hot water

∞ (in alcohol) ∞ (in benzene)

∞ (in ether)

## ETHYL METHYL OXALATE

Synonyms: methyl ethyl oxalate

Formula:  $\text{CH}_3\text{OCCCOOC}_2\text{H}_5$ 

Formula Weight: 132.1

Boiling Point: 173.7°C. (at 760 mm.)

Specific Gravity: 1.156(0/0)

Solubility:

insoluble in water

very soluble in alcohol and ether

## 3-ETHYL-2-METHYLPENTANE

Synonyms:

diethylisopropylmethane

octane

Formula:  $(\text{CH}_3)_2\text{CHCH}(\text{C}_2\text{H}_5)_2$ 

Formula Weight: 114.2

Boiling Point: 114.0°C. (at 760 mm.)

Specific Gravity: 0.7078

Refractive Index: 1.4016

Solubility:

insoluble in water

slightly soluble in alcohol

soluble in ether

## 3-ETHYL-3-METHYLPENTANE

Synonyms:

octane

triethylmethylethane

Formula:  $\text{CH}_3\text{C}(\text{C}_2\text{H}_5)_3$ 

Formula Weight: 114.2

Boiling Point: 119.0°C. (at 760 mm.)

Specific Gravity: 0.712

Solubility:

insoluble in water soluble in ether

## 3-ETHYL-2-METHYL-3-PENTANOL

Synonyms: diethylisopropylcarbinol

Formula:  $(\text{CH}_3)_2\text{CHCOH}(\text{C}_2\text{H}_5)_2$ 

Formula Weight: 130.2

Boiling Point: 159 to 161°C. (at 750 mm.)

Specific Gravity:

0.8463 at 0°C.

0.8295(20/0)

**Solubility:**

insoluble in water

soluble in alcohol and ether

**ETHYL METHYL SUCCINATE**

Synonyms: methyl ethyl succinate

Formula:  $\text{CH}_3\text{OOCCH}_2\text{CH}_2\text{COOC}_2\text{H}_5$ 

Formula Weight: 160.2

Melting Point:  $-20^\circ\text{C}$ .Boiling Point:  $208.2^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 1.093 at  $0^\circ\text{C}$ .**Solubility:**

insoluble in water

very soluble in alcohol and ether

**ETHYL METHYL SULFIDE**

Synonyms: methyl ethyl sulfide

Formula:  $\text{CH}_3\text{SC}_2\text{H}_5$ 

Characteristics: oily

Formula Weight: 76.2

Melting Point:  $-104.8^\circ\text{C}$ .Boiling Point:  $66.9^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 0.837 at  $20^\circ\text{C}$ .**Solubility:**

insoluble in water

 $\infty$  (in alcohol)  $\infty$  (in ether)**ETHYL S-METHYLXANTHATE**Formula:  $\text{C}_2\text{H}_5\text{OCSSCH}_3$ 

Formula Weight: 136.2

Boiling Point: 183 to  $184^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.119(25/4)

**Solubility:**

insoluble in water

soluble in alcohol and ether

**ETHYLMORPHOLINE**Formula:  $\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{NC}_2\text{H}_5$ 

Formula Weight: 115.2

Boiling Point:  $138^\circ\text{C}$ . (at 760 mm.)Vapor Pressure (mm. Hg): 16.0 at  $20^\circ\text{C}$ .**Specific Gravity:**

0.916(20/20)

7.6 lbs. per gal. at  $20^\circ\text{C}$ .Flash Point:  $89.6^\circ\text{F}$ . (open)**Uses:**

solvent for dyes, oils, and resins

organic synthesis of dyes

rubber accelerators

emulsifiers pharmaceuticals

**Solubility:** $\infty$  (of water) $\infty$  (in water)**ETHYLMORPHOLINE ETHYL ETHER**

Synonyms: morpholineethanol ethyl ether

Formula:  $\text{O}:(\text{CH}_2\text{CH}_2)_2:\text{NC}_2\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 159.2

Boiling Point:  $206.2^\circ\text{C}$ . (at 760 mm.)**Specific Gravity:**

0.956(20/20)

0.9648

**Uses:**

corrosion inhibitor

intermediate for dyes

emulsifiers

rubber accelerators

Solubility: miscible with water

**ETHYL MYRISTATE****Synonyms:**

ethyl tetradecanoate

myristic acid ethyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_{12}\text{COOC}_2\text{H}_5$ 

Formula Weight: 256.4

Melting Point:  $10.5$  to  $11.9^\circ\text{C}$ .Boiling Point:  $295^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8595(20/4)

**Solubility:**

insoluble in water soluble in alcohol

slightly soluble in ether

## 1-ETHYLNAPHTHALENE

## Synonyms:

$\alpha$ -ethylnaphthalene  
 $\alpha$ -naphthylethane

Formula:  $C_{10}H_7C_2H_5$ 

Formula Weight: 156.2

## Melting Point:

-27° C.                      < -14° C.

## Boiling Point:

258° C. with decomposition

## Specific Gravity:

1.018(20/4)                      0.990(25/25)

## Solubility:

insoluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## 2-ETHYLNAPHTHALENE

## Synonyms:

$\beta$ -ethylnaphthalene  
 $\beta$ -naphthylethane

Formula:  $C_{10}H_7C_2H_5$ 

Formula Weight: 156.2

Melting Point: -19° C.

Boiling Point: 251° C. (at 760 mm.)

Specific Gravity: 1.008 at 0° C.

## Solubility:

insoluble in water                       $\infty$  (in alcohol)  
 $\infty$  (in ether)

ETHYL  $\alpha$ -NAPHTHYLACETATEFormula:  $C_{10}H_7CH_2COOC_2H_5$ 

## Characteristics:

nearly odorless                      pale straw color

Formula Weight: 214.3

Boiling Point: 158 to 160° C. (at 3 mm.)

Specific Gravity: 1.106(25/25)

Refractive Index: 1.579 at 25° C.

## Solubility:

insoluble in water  
 miscible with methanol, ether, carbon tetrachloride, acetin, benzene, and VMP naphtha

N-ETHYL-1-NAPHTHYLAMINESynonyms: ethyl- $\alpha$ -naphthylamineFormula:  $C_{10}H_7NHC_2H_5$ 

Characteristics: oily

Formula Weight: 171.2

## Boiling Point:

305° C. (at 760 mm.)  
 303° C. (at 723 mm.)  
 187 to 190° C. (at 20 mm.)

Specific Gravity: 1.060(20/4)

Refractive Index: 1.64773 at 15.1° C.

## Solubility:

insoluble in water  
 soluble in alcohol and ether

N-ETHYL-2-NAPHTHYLAMINESynonyms: ethyl- $\beta$ -naphthylamineFormula:  $C_{10}H_7NHC_2H_5$ 

Formula Weight: 171.2

Melting Point: &lt; -15° C.

## Boiling Point:

315 to 317° C. (at 760 mm.)  
 305 to 307° C. (at 760 mm.)

Specific Gravity: 1.057(20/4)

Refractive Index: 1.65440 at 21.3° C.

## Solubility:

insoluble in water  
 soluble in alcohol and ether

## ETHYL 1-NAPHTHYL ETHER

## Synonyms:

1-ethoxynaphthalene  
 ethyl  $\alpha$ -naphthyl ether

Formula:  $C_{10}H_7OC_2H_5$

Formula Weight: 172.2

Melting Point:  $5.5^{\circ}C$ .

Boiling Point:

$276.4^{\circ}C$ . (at 760 mm.)

$160^{\circ}C$ . (at 19 mm.)

Specific Gravity: 1.061(20/4)

Refractive Index: 1.59509 at  $32.5^{\circ}C$ .

Solubility:

insoluble in water

very soluble in alcohol and ether

#### ETHYL NICOTINATE

Formula:  $C_5H_4NCOOC_2H_5$

Characteristics: oily

Formula Weight: 151.2

Melting Point: 8 to  $9^{\circ}C$ .

Boiling Point:  $225^{\circ}C$ . (at 760 mm.)

Solubility:

slightly soluble in water

soluble in alcohol, ether, and benzene

#### ETHYL NITRATE

Synonyms: nitric ether

Formula:  $C_2H_5ONO_2$

Characteristics:

pleasant odor                  sweet taste

Formula Weight: 91.1

Melting Point:  $-112$  to  $-102^{\circ}C$ .

Boiling Point:

$87$  to  $88.7^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.105(20/4)                  1.108(20/20)

1.100(25/4)

Refractive Index: 1.38484 at  $21.5^{\circ}C$ .

Surface Tension (dynes per cm.):

$28.7$  at  $20^{\circ}C$ .

Inflammability Range (volume per cent in air): 3.8 (lower limit)

Flash Point:

$500^{\circ}F$ . (closed)

$500^{\circ}F$ . (open)

Heat of Combustion (kilogram-calories per mole):  $322.4$  (gas)

Uses: organic syntheses

Solubility (grams per 100 ml.):

1.3 at  $35^{\circ}C$ . (in water)

$\infty$  (in alcohol)

very soluble in ether

Additional Data:

vapor density, 3.14

inflammable

#### ETHYL NITRITE

Synonyms:

hyponitrous ether      nitrous ether

Formula:  $C_2H_5ONO$

Characteristics:

colorless to yellow

volatile

ethereal

highly aromatic odor

Formula Weight: 75.1

Boiling Point:  $17^{\circ}C$ . (at 760 mm.)

Specific Gravity: 0.900 at  $15.5^{\circ}C$ .

Inflammability Range (volume per cent in air):

3.0 (lower limit)      > 50 (upper limit)

Flash Point:

$-31^{\circ}F$ . (closed)

$-30^{\circ}F$ . (open)

Heat of Combustion (kilogram-calories per mole):  $322.6$  (gas)

Uses:

organic syntheses      essences

medicines

Solubility:

very slightly soluble in water with decomposition

$\infty$  (in alcohol)

very soluble in ether

## ETHYL NITRITE (Cont.)

## Additional Data:

vapor density, 2.59  
 decomposes on standing  
 should be stored cool in tightly closed  
 containers and away from light

## ETHYL NITROACETATE

Synonyms: nitroacetic acid ethyl ester

Formula:  $\text{CH}_2\text{NO}_2\text{COOC}_2\text{H}_5$

Formula Weight: 133.1

Boiling Point: 105 to 107° C. (at 760 mm.)

Specific Gravity: 1.199(20/4)

## Solubility:

very slightly soluble in water  
 ∞ (in alcohol)

o-ETHYLNITROBENZENE

Synonyms: o-nitroethylbenzene

Formula:  $\text{NO}_2\text{C}_6\text{H}_4\text{C}_2\text{H}_5$

Formula Weight: 151.2

Melting Point: -23° C.

Boiling Point: 227 to 228° C. (at 760 mm.)

Specific Gravity: 1.126 at 24.5° C.

## Solubility:

insoluble in water  
 very soluble in alcohol  
 soluble in ether

p-ETHYLNITROBENZENE

Synonyms: p-nitroethylbenzene

Formula:  $\text{NO}_2\text{C}_6\text{H}_4\text{C}_2\text{H}_5$

Formula Weight: 151.2

Melting Point: -32° C.

Boiling Point: 245 to 246° C. (at 760 mm.)

Specific Gravity: 1.124 at 25° C.

## Solubility:

insoluble in water  
 very soluble in alcohol  
 soluble in ether

## ETHYL NITROMALONATE

## Synonyms:

diethyl nitromalonate  
 nitromalonic acid diethyl ester  
 nitromalonic ester

Formula:  $\text{NO}_2\text{CH}(\text{COOC}_2\text{H}_5)_2$

Formula Weight: 205.2

Boiling Point: 152 to 153° C. (at 18 mm.)

Specific Gravity: 1.199(20/4)

Solubility: insoluble in water

## 3-ETHYL-3-NITROPENTANE

## Synonyms:

3-nitro-3-ethylpentane nitroheptane

Formula:  $(\text{C}_2\text{H}_5)_3\text{CNO}_2$

Formula Weight: 145.2

Boiling Point: 185 to 190° C. (at 760 mm.)

Specific Gravity: 0.955 at 0° C.

N-ETHYL-N-NITROSOANILINE

## Synonyms:

ethyl phenyl nitrosoamine  
 nitrosoethylaniline

Formula:  $\text{C}_6\text{H}_5\text{N}(\text{NO})\text{C}_2\text{H}_5$

## Characteristics:

yellow oily

Formula Weight: 150.2

Boiling Point: 119 to 120° C. (at 15 mm.)

Specific Gravity: 1.087(20/4)

Solubility: insoluble in water

## 5-ETHYL-2-NONANOL

## Synonyms: undecanol

Formula:  $\text{C}_4\text{H}_9\text{CH}(\text{C}_2\text{H}_5)\text{C}_2\text{H}_4\text{CHOHCH}_3$

Characteristics: mild odor

Formula Weight: 172.3

Boiling Point: 225.4° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.04 at 20° C.

## Specific Gravity:

0.836(20/20)6.96 lbs. per gal. at 20°C.Flash Point: 235° F. (open)

## Uses:

antifoaming agent  
 synthetic intermediate in manufacture  
 of dyes, drugs, cosmetic agents,  
 detergents, and wetting agents

Solubility (grams per 100 ml.):

2.1 (of water) at 20°C.<0.02 (in water) at 20°C.

## Additional Data:

does not turn rancid on oxidation or  
 polymerization

## 3-ETHYL-3-OCTANOL

## Synonyms:

amyldiethylcarbinol  
 amyldiethylmethanol  
tert-decyl alcohol

Formula:  $(C_2H_5)_2COH(CH_2)_4CH_3$ 

Characteristics: oily

Formula Weight: 158.3

Boiling Point: 199°C. (at 760 mm.)

Specific Gravity: 0.8360(15/4)

## Solubility:

insoluble in water    soluble in alcohol

## \* ETHYL OCTYL ETHER

Synonyms: 1-ethoxyoctane

Formula:  $C_2H_5O(CH_2)_7CH_3$ 

Formula Weight: 158.3

Boiling Point: 182 to 189°C. (at 760 mm.)

Specific Gravity:

0.794(17/4)

0.801 at 0°C.

## Solubility:

insoluble in water    soluble in alcohol  
                               soluble in ether

## ETHYL OLEATE

Synonyms: oleic acid ethyl ester

Formula:

 $CH_3(CH_2)_7CH:CH(CH_2)_7COOC_2H_5$ 

Characteristics:

yellow                            oily

Formula Weight: 310.5

Melting Point: -32°C.

Boiling Point:

205 to 208°C. (at 10 mm.)

205 to 208°C. (at 760 mm.) decomposes

Specific Gravity:

0.871 at 15°C.

0.8735(20/20)

0.8671 at 25°C.

Refractive Index: 1.45189Flash Point: 347.5° F. (closed)

## Uses:

special solvent  
 plasticizer  
 lubricant  
 preparations containing lubricating,  
 plasticizing or water-resisting  
 characteristics

Solubility:

insoluble in water    ∞ (in alcohol)  
                               ∞ (in ether)

## ETHYL ORTHOACETATE

Formula:  $CH_3C(OC_2H_5)_3$ 

Synonyms:

ethenyl triethyl ether  
 orthoacetic acid ethyl ester  
 1,1,1-triethoxy ethane  
 triethyl orthoacetate

Formula Weight: 162.2

Boiling Point: 142°C. (at 760 mm.)

Specific Gravity:

0.94 at 22°C.

0.8847(25/4)

Solubility:

∞ (in alcohol)            ∞ (in ether)

## ETHYL ORTHOCARBONATE

## Synonyms:

orthocarbonic acid ethyl ester  
tetraethoxyethane  
tetraethyl orthocarbonate

Formula:  $C(OC_2H_5)_4$ 

Formula Weight: 192.3

Boiling Point: 158 to 159°C. (at 760 mm.)

Specific Gravity:

0.919(19/4) 0.9197(18/4)

Refractive Index: 1.393

Solubility:

 $\infty$  (in alcohol)  $\infty$  (in ether)

## ETHYL ORTHOFORMATE

## Synonyms:

aethon  
orthoformic acid ethyl ester  
triethoxymethane  
triethyl orthoformate

Formula:  $HC(OC_2H_5)_3$ 

Characteristics:

sweetish odor of pine needles  
flavor of honey and carrots

Formula Weight: 148.2

Melting Point: -76.1°C.

Boiling Point: 143 to 146°C. (at 760 mm.)

Specific Gravity: 0.8971(20/4)

Solubility:

very slightly soluble in water  
(decomposes)  
very soluble in alcohol  
very soluble in ether

## ETHYL ORTHOSILICATE

## Synonyms:

ethyl silicate  
orthosilicic acid ethyl ester  
silicon ester  
tetraethyl orthosilicate

Formula:  $Si(OC_2H_5)_4$ 

Characteristics: mild odor

Formula Weight: 208.3

Freezing Point: -77°C.

Boiling Point:

165.5 to 168.1°C. (at 760 mm.)

160 to 170°C. (at 760 mm.)

Vapor Pressure (mm. Hg): 1.0 at 20°C.

Specific Gravity:

0.9356(20/20) 0.9356(20/20)

0.933(20/4)

7.8 lbs. per gal. at 20°C.

Refractive Index: 1.3832

Viscosity (centipoises): 0.60 at 20°C.

Flash Point: 125°F. (open)

Uses:

heat-resisting paints  
preservative for stone, concrete and  
plaster  
nitrocellulose lacquers  
mold ingredient for casting high  
melting metals and alloys

Solubility:

water is insoluble in this compound  
slight decomposition in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## ETHYL OXALATE

## Synonyms:

diethyl ethanedioate  
diethyl oxalate  
oxalic ether  
oxalic acid (di-) ethyl ester

Formula:  $(COOC_2H_5)_2$ 

Characteristics: mild pleasant odor

Formula Weight: 146.1

Melting Point:

-40.6°C. -41.5°C.

Boiling Point:

185.4°C. (at 760 mm.)

185.7°C. (at 760 mm.)

180 to 190°C. (at 760 mm.)

## Specific Gravity:

1.08246 at 15° C.      1.075 to  
 1.0785(20/4)      1.079(20/20)  
 8.96 lbs. per gal. at 20° C.

## Refractive Index: 1.41011

## Surface Tension (dynes per cm.):

33.2 at 10° C.      26.6 at 70° C.  
 32.0 at 20° C.

## Viscosity (centipoises):

10% 1/2 sec. RS nitrocellulose  
 solution, 380

## Flash Point: 168° F. (open)

## Heat of Vaporization (gram-calories per g.): 67.6 at 15° C.

## Heat of Combustion (kilogram-calories per mole): 716.0 (liquid)

## Uses:

organic syntheses      lacquers  
 dye intermediate      pharmaceuticals  
 solvent for cellulose esters and  
 ethers, resins

## Solubility:

slightly soluble in water  
 ∞ (in alcohol)      ∞ (in ether)  
 miscible with common organic solvents

## Additional Data:

coefficient of expansion,  
 0.00056 per ° F.      0.00101 per ° C.  
 vapor density, 5.04  
 dilution ratios, nitrocellulose solution  
 method,  
 with toluene . . . . . 3.5  
 with petroleum naphtha . . . . . 0.7

## Blush Resistance at 90° F.

(10% 1/2 sec. RS nitrocellulose solution)

	Clear	Blush
Relative humidity	90%	---

## ETHYL PELARGONATE

## Synonyms:

ethyl nonanoate      ethyl nonylate  
 ethyl n-nonoate      wine-ether  
 pelargonic acid ethyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{COOC}_2\text{H}_5$

## Characteristics:

pineapple flavor  
 pleasant fruity odor like that of rose  
 petals  
 slight sweet somewhat sour taste

## Formula Weight: 186.3

## Melting Point: -44.5 to -36.7° C.

## Boiling Point:

227.5° C. (at 760 mm.)  
 227 to 228° C. (at 757 mm.)

## Specific Gravity:

0.8657(20/4)      0.866 at 17.5° C.

## Refractive Index: 1.42200

## Uses:

substitute for cognac oil  
 brandy, coffee, butter, and many  
 synthetic flavors

## Solubility:

insoluble in water      ∞ (in ether)  
 soluble in alcohol

## 3-ETHYLPENTANE

## Synonyms:

triethylmethane      heptane

Formula:  $(\text{C}_2\text{H}_5)_3\text{CH}$ 

## Formula Weight: 100.2

## Melting Point:

-125.6° C.      -118.8° C.  
 -94.5° C.      -118.6° C.

## Boiling Point: 93.3° C. (at 760 mm.)

## Specific Gravity: 0.6984(20/4)

## Refractive Index: 1.39340

Specific Heat (Btu. per lb. per ° F.):  
0.519 (liquid) at 77° F.Heat of Fusion (gram-calories per g.):  
22.6 at 15° C.

## Heat of Combustion (kilogram-calories per mole): 1149.9 (liquid)

## Uses: organic syntheses

## 3-ETHYLPENTANE (Cont.)

## Solubility:

insoluble in water    soluble in alcohol  
very soluble in ether

## Additional Data:

aniline equivalent, -4  
aniline point, 150.3° F.  
critical temperature, 513.7° F.  
critical pressure, 420 psia  
coefficient of expansion,  
0.00068 at 68° F.  
specific gravity of gas (ideal)  
(air = 1.0), 3.4592, of liquid  
(in vacuo),  
0.69818(20/4)° C. 0.70277(60/60)° F.  
API gravity at 60° F., 69.8  
liquid density (in vacuo) at 60° F.,  
5.8592 lbs./gal.  
total heating values, (at 77° F.),  
20666 Btu./lb.,  
119,650 Btu.cu. ft.-gas

## 3-ETHYL-2-PENTANOL

Synonyms: heptyl alcohol

Formula:  $(C_2H_5)_2CHCHOHCH_3$

Formula Weight: 116.2

Boiling Point: 148 to 152° C. (at 760 mm.)

Specific Gravity: 0.853 at 0° C.

## Solubility:

∞ (in alcohol)    ∞ (in ether)

## 3-ETHYL-3-PENTANOL

## Synonyms:

triethyl carbinol    heptyl alcohol

Formula:  $(C_2H_5)_3COH$

Characteristics: oily

Formula Weight: 116.2

Boiling Point: 142° C. (at 764 mm.)

Specific Gravity: 0.839(20/4)

## Solubility:

∞ (in alcohol)    ∞ (in ether)

## 2-ETHYL-1-PENTENE

## Synonyms:

1-ethyl-1-propylethylene  
3-methylenehexane

Formula:  $CH_2:C(C_2H_5)CH_2CH_2CH_3$

Formula Weight: 98.2

## Boiling Point:

93.9 to 94.3° C. (at 760 mm.)

Specific Gravity: 0.7079

## 3-ETHYL-2-PENTENE

## Synonyms:

1,1-diethyl-2-methylethylene

Formula:  $CH_3CH:C(C_2H_5)_2$

Formula Weight: 98.2

## Boiling Point:

94.8 to 94.9° C. (at 760 mm.)

Specific Gravity: 0.7172

m-ETHYLPHENOL

Synonyms: 3-ethylphenol

Formula:  $C_2H_5C_6H_4OH$

Formula Weight: 122.2

Melting Point: -4° C.

Boiling Point: 214° C. (at 752 mm.)

## Specific Gravity:

1.025 at 0° C.    1.001(25/25)

## Solubility:

slightly soluble in water  
very soluble in alcohol  
very soluble in ether

o-ETHYLPHENOL

## Synonyms:

2-ethylphenol    phlorol

Formula:  $C_2H_5C_6H_4OH$

Formula Weight: 122.2

Melting Point: -45° C.

**Boiling Point:**

207.5° C. (at 760 mm.)

207 to 208° C. (at 756 mm.)

**Specific Gravity:**

1.018(25/25)

1.0374 at 12° C.

**Solubility:**

slightly soluble in water

very soluble in alcohol

very soluble in ether

soluble in benzene

**ETHYL  $\gamma$ -PHENOXYBUTYRATE****Synonyms:** $\gamma$ -phenoxybutyric acid ethyl ester**Formula:**  $C_6H_5OCH_2CH_2CH_2COOC_2H_5$ **Formula Weight:** 208.3**Boiling Point:** 156 to 162° C. (at 20 mm.)**Specific Gravity:** 1.048(23/25)**ETHYL PHENYLBROMOACETATE****Synonyms:**

dl-phenylbromoacetic acid ethyl ester

**Formula:**  $C_6H_5CHBrCOOC_2H_5$ **Characteristics:** oily**Formula Weight:** 243.1**Boiling Point:** 145° C. (at 15 mm.)**Specific Gravity:** 1.415(20/4)**1-ETHYL-1-PHENYLHYDRAZINE****Synonyms:** $\underline{d}$ ,  $\underline{d}$ -ethyl phenylhydrazine**Formula:**  $C_6H_5(C_2H_5)NNH_2$ **Characteristics:** oily**Formula Weight:** 136.2**Boiling Point:** 237° C. (at 760 mm.)**Specific Gravity:** 1.018(15/4)**1-ETHYL-2-PHENYLHYDRAZINE****Synonyms:** $\underline{d}$ ,  $\beta$ -ethyl phenylhydrazine**Formula:**  $C_6H_5NHNHC_2H_5$ **Characteristics:** oily**Formula Weight:** 136.2**Boiling Point:**

104° C. (at 10 mm.)

237 to 240° C. (at 760 mm.) in nitrogen

**Specific Gravity:** 1.004(15/15)**Refractive Index:**

1.57108 at 20.8, helium line

**Solubility:**

slightly soluble in water

very soluble in alcohol

very soluble in ether

**ETHYL PHENYLPROPIOLATE****Synonyms:**

phenylpropionic acid ethyl ester

**Formula:**  $C_6H_5C:CCOOC_2H_5$ **Characteristics:** oily**Formula Weight:** 174.2**Boiling Point:**

260 to 270° C. (at 760 mm.)

slight decomposition

**Specific Gravity:** 1.063(13/4)**ETHYL PHENYL SULFIDE****Synonyms:** thiophenetole**Formula:**  $C_6H_5SC_2H_5$ **Formula Weight:** 138.2**Boiling Point:** 205 to 206° C. (at 760 mm.)**Specific Gravity:** 1.024(15/4)**ETHYL PHOSPHATE****Synonyms:** triethyl phosphate**Formula:**  $(C_2H_5)_3PO_4$ **Characteristics:** mild odor

## ETHYL PHOSPHATE (Cont.)

Formula Weight: 182.2

Melting Point: -56.4° C.

Boiling Point:

211.0° C. (at 760 mm.)

215 to 216° C. (at 760 mm.)

200 to 220° C. (at 760 mm.)

Specific Gravity:

1.0686(25/4)                      1.068(20/4)

8.90 lbs. per gal. at 68° F.

Refractive Index:

1.40616 at 10° C.      1.4055Flash Point: 240° F. (closed)

Uses:

catalyst in chemical syntheses

high boiling solvent

plasticizer for cellulose acetate and  
cellulose nitrate

Solubility (grams per 100 ml.):

100 (in water) at 25° C., decomposes

soluble in alcohol      soluble in ether

miscible with most organic solvents

## ETHYLPHOSPHINE

Synonyms: phosphinoethane

Formula:  $C_2H_5PH_2$ 

Formula Weight: 62.1

Boiling Point: 25° C. (at 760 mm.)

Specific Gravity: &lt;1

Solubility: decomposes in water

## ETHYL PHOSPHITE

Synonyms: triethyl phosphite

Formula:  $(C_2H_5)_3PO_3$ 

Formula Weight: 166.2

Boiling Point: 156.5° C. (at 760 mm.)

Specific Gravity: 0.9687(20/4)

Refractive Index: 1.4079

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## ETHYL PIMELATE

Synonyms:

diethyl pimelate

pimelic acid (di) ethyl ester

Formula:  $CH_2(CH_2CH_2COOC_2H_5)_2$ 

Characteristics: oily

Formula Weight: 216.3

Boiling Point: 252 to 255° C. (at 748 mm.)

Specific Gravity: 0.999(15/15)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## 1-ETHYLPYPERIDINE

Synonyms: N-ethylpyperidineFormula:  $C_2H_5NC_5H_{10}$ 

Formula Weight: 113.2

Boiling Point: 130.8° C. (at 760 mm.)

Specific Gravity: 0.8249 at 20° C.

Refractive Index: 1.4440

dl-2-ETHYLPYPERIDINESynonyms: dl-d-ethylpyperidineFormula:  $NHCH(C_2H_5)(CH_2)_4$ 

Formula Weight: 113.2

Boiling Point: 143° C. (at 760 mm.)

Specific Gravity: 0.867 at 0° C.

Solubility (grams per 100 ml.):

5 (in water)

dl-3-ETHYLPYPERIDINESynonyms: dl-β-ethylpyperidineFormula:  $NHCH_2CH(C_2H_5)(CH_2)_3$

Formula Weight: 113.2

Boiling Point:

152.6° C. (at 760 mm.)

155° C. (at 760 mm.)

Specific Gravity: 0.8658 at 0° C.

Solubility:

very slightly soluble in water

### ETHYL PROPARGYL ETHER

Synonyms: 3-ethoxypropyne

Formula:  $\text{CH}_3\text{CCH}_2\text{OC}_2\text{H}_5$

Formula Weight: 84.1

Boiling Point: 80 to 82° C. (at 760 mm.)

Specific Gravity:

0.8326

0.833(20/4)

Refractive Index: 1.40390

Solubility:

insoluble in water soluble in ether

very soluble in alcohol

### ETHYL PROPIOLATE

Synonyms: propiolic acid ethyl ester

Formula:  $\text{CH}_3\text{:CCOOC}_2\text{H}_5$

Formula Weight: 98.1

Boiling Point: 119.5° C. (at 760 mm.)

Specific Gravity: 0.968(15/15)

Solubility:

insoluble in water

very soluble in alcohol, ether, and  
chloroform

### ETHYL PROPIONATE

Synonyms:

propionic acid ethyl ester

propionic ester propionic ether

Formula:  $\text{CH}_3\text{CH}_2\text{COOC}_2\text{H}_5$

Characteristics:

fruity odor similar to pineapples

Formula Weight: 102.1

Melting Point:

-73.9° C.

-72.6° C.

Boiling Point:

99.1° C. (at 760 mm.)

90 to 118° C. (at 760 mm.)

Specific Gravity:

0.8957 at 15° C.

0.891(20/4)

0.8846 at 25° C.

7.41 lbs. per gal. at 20° C.

Refractive Index:

1.38385 at 20.2° C. 1.3844

Surface Tension (dynes per cm.):

25.9 at 5° C.

19.5 at 100° C.

24.2 at 20° C.

Viscosity (centipoises):

0.6967 at 0° C.

0.4282 at 40° C.

0.5367 at 20° C.

0.2705 at 90° C.

Flash Point:

70° F. (open)

54° F. (closed)

Heat of Vaporization (gram-calories  
per g.): 80.1 at 15° C.

Heat of Combustion (kilogram-calories  
per mole): 690.8 (liquid)

Uses:

solvent for cellulose esters and ethers

cutting agent for pyroxylin

fruit syrups

resins

Solubility (grams per 100 ml.):

1.20 by weight (of water) at 20° C.

2.4 (in water) at 20° C.

∞ (in alcohol)

∞ (in ether)

Additional Data:

vapor density, 3.52

critical temperature, 272.8° C.

critical pressure, 33.2 atm.

coefficient of expansion,

0.00125 at 10 to 30° C.

dilution ratios:

with toluene . . . . . 2.1

with petroleum naphtha . . . . 0.8

d-ETHYLPROPYL ACETATE

## Synonyms:

acetic acid d-ethylpropyl ester  
 3-pentanol acetate  
 2-ethylpropyl acetate  
 diethylcarbinol acetate  
 diethylmethanol acetate

Formula:  $\text{CH}_3\text{COOCH}(\text{C}_2\text{H}_5)_2$ 

Formula Weight: 130.2

Boiling Point: 131°C. (at 760 mm.)

## Specific Gravity:

0.8712(20/4)

7.27 lbs. per gal. at 20°C.

## Solubility:

&lt;1 (of water) &lt;1 (in water)

## ETHYL PROPYLACETOACETATE

## Synonyms:

propylacetoacetic acid ethyl ester

Formula:  $\text{CH}_3\text{COCH}(\text{C}_3\text{H}_7)\text{COOC}_2\text{H}_5$ 

Formula Weight: 172.2

Boiling Point: 223 to 226°C. (at 760 mm.)

Specific Gravity: 0.948(25/4)

## Solubility (grams per 100 ml.):

0.07 (in water) at 20°C.

soluble in alcohol

 $\infty$  (in ether)  $\infty$  (in benzene)d-ETHYLPROPYLAMINE

## Synonyms:

sec-n-amylamine

3-aminopentane

diethylcarbinylamine

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{NH}_2$ 

Characteristics: oily

Formula Weight: 87.2

Boiling Point: 90 to 91°C. (at 760 mm.)

Specific Gravity: 0.7487(20/4)

## Solubility:

 $\infty$  (in water)  $\infty$  (in ether)

very soluble in alcohol

## ETHYL PROPYL ETHER

## Synonyms: 1-ethoxypropane

Formula:  $\text{C}_2\text{H}_5\text{OC}_3\text{H}_7$ 

Formula Weight: 88.2

Melting Point: &lt; -79°C.

## Boiling Point:

61.4 to 64°C. (at 760 mm.)

61.7°C. (at 760 mm.)

Specific Gravity: 0.732(20/4)

Refractive Index: 1.36948

## Viscosity (centipoises):

0.4007 at 0.35°C. 0.2248 at 60.18°C.

0.3231 at 20.33°C.

Heat of Vaporization (gram-calories per g.): 82.7 at 15°C.

## Solubility:

soluble in water  $\infty$  (in alcohol) $\infty$  (in ether)

## Additional Data:

critical temperature, 227.4°C.

critical pressure, 32.1 atm.

## 2-ETHYLPYRIDINE

## Synonyms:

d-ethylpyridine d-lutidineFormula:  $\text{C}_2\text{H}_5\text{C}_5\text{H}_4\text{N}$ 

Formula Weight: 107.2

Boiling Point: 148.8°C. (at 760 mm.)

Specific Gravity: 0.950 at 0°C.

Refractive Index: 1.50214 at 22.5°C.

## Solubility:

slightly soluble in water

very soluble in ether

 $\infty$  (in alcohol)

## 3-ETHYLPYRIDINE

## Synonyms:

 $\beta$ -ethylpyridine  $\beta$ -lutidineFormula:  $\text{C}_2\text{H}_5\text{C}_5\text{H}_4\text{N}$ 

Formula Weight: 107.2

## Boiling Point:

165.3° C. (at 760 mm.)

162° C. (at 760 mm.)

## Specific Gravity:

0.945 at 15° C.      0.940 at 23° C.

0.959(0/4)

## Solubility:

very slightly soluble in water

soluble in alcohol      soluble in ether

## 4-ETHYLPYRIDINE

## Synonyms:

 $\gamma$ -ethylpyridine       $\gamma$ -lutidineFormula:  $C_2H_5C_5H_4N$ 

Formula Weight: 107.2

Boiling Point: 166° C. (at 760 mm.)

Specific Gravity: 0.936 at 20° C.

## Solubility:

soluble in dilute acids

## 1-ETHYLPYRROLE

## Synonyms:

N-ethylpyrrole  
ethyl pyrrolylamineFormula:  $C_2H_5NC_4H_4$ 

\* Formula Weight: 95.1

Boiling Point: 130 to 131° C. (at 760 mm.)

Specific Gravity: 0.888 at 16° C.

## Solubility:

soluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ETHYL PYRUVATE

Synonyms: pyruvic acid ethyl ester

Formula:  $CH_3COCOOC_2H_5$ 

## Characteristics:

distinct rum-arrack aroma

Formula Weight: 116.1

## Boiling Point:

144° C. (at 760 mm.)

155° C. (at 760 mm.)

55° C. (at 17 mm.)

Specific Gravity: 1.060(16/4)

Uses: synthetic rum flavors

## Solubility:

slightly soluble in water

 $\infty$  (in alcohol)       $\infty$  (in ether)

## ETHYL SALICYLATE

## Synonyms:

salicylic acid ethyl ester

ethyl hydroxybenzoate

sal ethyl

salicylic ether

Formula:  $HOC_6H_4COOC_2H_5$ 

## Characteristics:

highly refractive odor

odor is similar to methyl salicylate

weak, sweet and somewhat bitter taste

strawberry flavor

Formula Weight: 166.2

Melting Point: 1.3° C.

## Boiling Point:

231.5° C. (at 760 mm.)

234° C. (at 760 mm.)

## Specific Gravity:

1.1362(15/4)

1.131(20/4)

1.13(25/25)

## Refractive Index:

1.52511 at 14.4° C.      1.5226

Viscosity (centipoises): 1.772 at 45° C.

Heat of Combustion (kilogram-calories  
per mole): 1051.2 (liquid)

## Uses:

synthetic apricot, blackberry,  
cranberry, grenadine, melon,  
raspberry, and strawberry flavors

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ETHYL SEBACATE

## Synonyms:

diethyl sebacate

sebacic acid (di) ethyl ester

## ETHYL SEBACATE (Cont.)

Formula:  $[(CH_2)_4COOC_2H_5]_2$ 

## Characteristics:

strong melon odor    melon flavor  
bitter-sweet taste

Formula Weight: 258.4

Melting Point:  $1.3^\circ C$ .

## Boiling Point:

308 $^\circ C$ . (at 760 mm.)305.5 $^\circ C$ . (at 760 mm.)

Specific Gravity: 0.9646(20/4)

Refractive Index: 1.4369

## Uses:

synthetic banana, current, melon,  
peach, pineapple, and raspberry  
essences

## Solubility (grams per 100 ml.):

0.008 (in water) at 20 $^\circ C$ .

soluble in alcohol    soluble in ether

## Additional Data:

optical rotation,  $[\alpha]$  +4 to 5 $^\circ$ 

## ETHYL SELENIDE

## Synonyms:

diethyl monoselenide  
diethyl selenide  
selenium ethyl

Formula:  $(C_2H_5)_2Se$ 

Formula Weight: 137.1

Boiling Point: 108.0 $^\circ C$ . (at 760 mm.)

Specific Gravity: 1.2300(20/4)

Refractive Index: 1.4768

Inflammability Range (volume per cent  
in air): 2.5 (lower limit)

Solubility: insoluble in water

Additional Data: vapor density, 4.73

## ETHYL SUBERATE

## Synonyms:

diethyl suberate  
suberic acid (di-)ethyl ester

Formula:  $(CH_2CH_2CH_2COOC_2H_5)_2$ 

Formula Weight: 230.3

Boiling Point: 282 to 286 $^\circ C$ . (at 760 mm.)

Specific Gravity: 0.982(20/4)

Uses: mulberry flavor

## Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## ETHYL SUCCINATE

## Synonyms:

diethyl succinate  
succinic acid (di-)ethyl ester

Formula:  $(CH_2COOC_2H_5)_2$ 

## Characteristics:

odor resembling ylang-ylang  
bitter, burning taste  
currant flavor

Formula Weight: 174.2

Melting Point: -20.8 $^\circ C$ .

## Boiling Point:

217.7 $^\circ C$ . (at 760 mm.)216.5 $^\circ C$ . (at 760 mm.)

Specific Gravity: 1.0402(20/4)

Refractive Index: 1.42007

Heat of Combustion (kilogram-calories  
per mole): 1007.3 (liquid)

## Uses:

synthetic currant, raspberry, and  
strawberry flavors

## Solubility:

insoluble in water  
 $\infty$  (in alcohol)     $\infty$  (in ether)

## ETHYL SULFATE

Synonyms: diethyl sulfate

Formula:  $(C_2H_5)_2SO_4$ 

## Characteristics:

oily  
faint, ethereal odor

Formula Weight: 154.2

## Melting Point:

-24.5° C.                      -25° C.

## Boiling Point:

208° C. (at 760 mm.)

slight decomposition

96° C. (at 15 mm.)

106 to 111° C. (at 760 mm.)

## Specific Gravity:

1.1842(15/4)                      1.1803(20/20)

1.172(25/4)

9.8 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg): 0.1 at 20° C.

## Surface Tension (dynes per cm.):

34.6 at 13° C.                      28.6 at 70° C.

32.5 at 32.5° C.

## Flash Point:

250° F. (open)                      220° F. (closed)

## Uses:

organic synthesis of ethyl compounds

## Solubility (grams per 100 ml.):

0.3 (of water) at 20° C.

0.7 (in water) at 20° C.

∞ (in alcohol) decomposes when hot

∞ (in ether)

## Additional Data:

hydrolyzes slowly      vapor density, 5.31

## ETHYL SULFIDE

## Synonyms:

diethyl sulfide                      ethylthioethane

Formula:  $(C_2H_5)_2S$

## Characteristics:

oily                      garlic-like odor

Formula Weight: 90.2

Melting Point: -102.1 to -99.5° C.

Boiling Point: 92 to 93° C. (at 760 mm.)

Specific Gravity: 0.837(20/4)

Refractive Index: 1.44233

## Viscosity (centipoises):

0.5619 at 0.21° C.      0.249 at 88° C.

0.4292 at 24.64° C.

Uses: organic syntheses

## Solubility (grams per 100 ml.):

0.313 (in water) at 20° C.

very soluble in alcohol

very soluble in ether

## Additional Data:

critical temperature, 283.8° C.

critical pressure, 39.1 atm.

## ETHYL SULFITE

Synonyms: diethyl sulfite

Formula:  $(C_2H_5)_2SO_3$

Formula Weight: 138.2

## Boiling Point:

158 to 161.3° C. (at 760 mm.)

159.0° C. (at 760 mm.)

## Specific Gravity:

1.1062(0/4)                      1.077(20/4)

Refractive Index: 1.4198 at 11° C.

## Solubility:

soluble in water, decomposes

soluble in alcohol      soluble in ether

## ETHYL SULFOXIDE

## Synonyms:

diethyl sulfoxide

ethylsulfinyethane

Formula:  $(C_2H_5)_2SO$

Characteristics: syrupy

Formula Weight: 106.2

Melting Point: 5° C.

## Boiling Point:

89° C. (at 15 mm.) decomposes

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

ETHYL dl-TARTRATE

## Synonyms:

diethyl dl-tartrate      diethyl racemate  
dl-tartaric acid (di-) ethyl ester

Formula:  $(CHOHCOOC_2H_5)_2$

ETHYL dl-TARTRATE (Cont.)

Formula Weight: 206.2

Melting Point: 17° C.

Boiling Point: 280° C. (at 760 mm.)

Specific Gravity: 1.2036(20/4)

## Solubility:

slightly soluble in water

∞ (in alcohol) ∞ (in ether)

soluble in common organic solvents

ETHYL d-TARTRATE

## Synonyms:

diethyl d-2, 3-dihydroxybutanedioatediethyl d-tartrated-tartaric acid (di-) ethyl esterFormula: (CHOHCOOC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>

Formula Weight: 206.2

Melting Point: 17° C.

Boiling Point: 280° C. (at 760 mm.)

Specific Gravity: 1.2036(20/4)

Refractive Index: 1.4454 at 25° C.

## Solubility:

soluble in water soluble in alcohol

∞ (in ether)

soluble in common organic solvents

## ETHYL TELLURIDE

## Synonyms:

diethyl telluride tellurium ethyl

Formula: (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>Te

Characteristics: red to yellow

Formula Weight: 185.7

Boiling Point: 137 to 138° C. (at 760 mm.)

Specific Gravity: 1.599(15/4)

## Solubility:

insoluble in water soluble in alcohol

## ETHYL THIOACETATE

Synonyms: thioacetic acid ethyl ester

Formula: CH<sub>3</sub>COSC<sub>2</sub>H<sub>5</sub>

Formula Weight: 104.2

Boiling Point: 116 to 117° C. (at 760 mm.)

Specific Gravity: 0.976(28/4)

Refractive Index: 1.4666

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## ETHYL THIOCYANATE

Synonyms: thiocyanic acid ethyl ester

Formula: C<sub>2</sub>H<sub>5</sub>SCN

Formula Weight: 87.1

Melting Point: -85.5° C.

Boiling Point: 144.4° C. (at 760 mm.)

Specific Gravity: 0.996(25/4)

Refractive Index: 1.466

Heat of Combustion (kilogram-calories  
per mole): 613.8 (liquid)

## Solubility:

insoluble in water ∞ (in alcohol)

∞ (in ether)

ETHYL m-TOLUATESynonyms: m-toluic acid ethyl esterFormula: CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>COOC<sub>2</sub>H<sub>5</sub>

Formula Weight: 164.2

## Boiling Point:

226.4° C. (at 760 mm.)

231° C. (at 750 mm.)

## Specific Gravity:

1.028

1.030(20/20)

Refractive Index: 1.50502 at 21.6° C.

## Solubility:

insoluble in water ∞ (in alcohol)

∞ (in ether)

ETHYL o-TOLUATE

Synonyms: o-toluic acid ethyl ester

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{COOC}_2\text{H}_5$

Formula Weight: 164.2

Melting Point:  $< -10^\circ\text{C}$ .

Boiling Point:

221.3 $^\circ\text{C}$ . (at 760 mm.)

227 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.033 1.032(25/25)

1.038(15/4)

Refractive Index: 1.50699 at 21.6 $^\circ\text{C}$ .

Solubility:

insoluble in water  $\infty$  (in alcohol)

$\infty$  (in ether)

ETHYL p-TOLUATE

Synonyms: p-toluic acid ethyl ester

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{COOC}_2\text{H}_5$

Formula Weight: 164.2

Boiling Point:

228 $^\circ\text{C}$ . (at 760 mm.)

235.5 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.026 1.024(25/25)

Refractive Index: 1.50888 at 18.2 $^\circ\text{C}$ .

Solubility:

insoluble in water  $\infty$  (in alcohol)

$\infty$  (in ether)

m-ETHYLTOLUENE

Synonyms:

1-ethyl-3-methylbenzene

3-ethyltoluene

Formula:  $\text{C}_2\text{H}_5\text{C}_6\text{H}_4\text{CH}_3$

Formula Weight: 120.2

Melting Point: -104.7 $^\circ\text{C}$ .

Boiling Point:

158 to 159 $^\circ\text{C}$ . (at 760 mm.)

162.5 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.869 at 20 $^\circ\text{C}$ .

Refractive Index: 1.49966 at 19.9 $^\circ\text{C}$ .

Solubility:

insoluble in water  $\infty$  (in alcohol)

$\infty$  (in ether)

o-ETHYLTOLUENE

Synonyms:

1-ethyl-2-methylbenzene

2-ethyltoluene

Formula:  $\text{C}_2\text{H}_5\text{C}_6\text{H}_4\text{CH}_3$

Formula Weight: 120.2

Melting Point:  $< -17^\circ\text{C}$ .

Boiling Point:

162 to 164.9 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.882(20/4)

Refractive Index: 1.50569 at 16.1 $^\circ\text{C}$ .

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

p-ETHYLTOLUENE

Synonyms:

1-ethyl-4-methylbenzene

4-ethyltoluene

Formula:  $\text{C}_2\text{H}_5\text{C}_6\text{H}_4\text{CH}_3$

Formula Weight: 120.2

Melting Point:  $< -20^\circ\text{C}$ .

Boiling Point:

162 to 162.5 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.862(20/4)

Refractive Index: 1.49303 at 22.8 $^\circ\text{C}$ .

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

ETHYL m-TOLUIDINE

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NHC}_2\text{H}_5$

Formula Weight: 135.2

Boiling Point: 221 to 222 $^\circ\text{C}$ . (at 760 mm.)

ETHYL o-TOLUIDINEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NHC}_2\text{H}_5$ 

Formula Weight: 135.2

Melting Point:  $< -15^\circ\text{C}$ .Boiling Point:  $215$  to  $216^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 0.948(25/4)

Solubility: insoluble in water

ETHYL p-TOLUIDINEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NHC}_2\text{H}_5$ 

Formula Weight: 135.2

Boiling Point:  $217^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 0.942(25/4)

Solubility: insoluble in water

ETHYL o-TOLYL ETHER

Synonyms:

o-cresyl ethyl ether2-ethoxytolueneethyl o-cresyl ethero-ethyl anisoleFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 136.2

Boiling Point:

 $180.1$  to  $184^\circ\text{C}$ . (at  $760$  mm.) $69.6$  to  $70.2^\circ\text{C}$ . (at  $12$  mm.)

Specific Gravity: 0.9592(13.3/4)

Refractive Index: 1.508 at  $13.3^\circ\text{C}$ .ETHYL m-TOLYL ETHER

Synonyms:

m-cresyl ethyl ether3-ethoxytolueneethyl m-cresyl etherm-ethyl anisoleFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Formula Weight: 136.2

Boiling Point:

 $192^\circ\text{C}$ . (at  $760$  mm.) $73$  to  $75^\circ\text{C}$ . (at  $10$  mm.)

Specific Gravity: 0.9560(0/0)

Refractive Index: 1.513

ETHYL p-TOLYL ETHER

Synonyms:

p-cresyl ethyl ether4-ethoxytolueneethyl p-cresyl etherp-ethyl anisoleFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Characteristics:

ylang-ylang odor      honey flavor

very sweet taste

Formula Weight: 136.2

Boiling Point:

 $188$  to  $189^\circ\text{C}$ . (at  $760$  mm.) $70$  to  $71^\circ\text{C}$ . (at  $15$  mm.)

Specific Gravity: 0.9662(0/0)

Refractive Index: 1.5058 at  $17.6^\circ\text{C}$ .

Uses: honey flavor

ETHYL p-TOLYL SULFIDESynonyms: ethyl p-cresyl sulfideFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SC}_2\text{H}_5$ 

Formula Weight: 152.3

Boiling Point:  $220$  to  $221^\circ\text{C}$ . (at  $760$  mm.)Specific Gravity: 1.002 at  $17.5^\circ\text{C}$ .

## ETHYL TRIAZOACETATE

Synonyms: triazoacetic acid ethyl ester

Formula:  $\text{N}_3\text{CH}_2\text{COOC}_2\text{H}_5$ 

Characteristics: oily

Formula Weight: 129.1

Boiling Point:  $70^\circ\text{C}$ . (at  $20$  mm.)

Specific Gravity: 1.127(20/20)

## ETHYL TRIBROMOACETATE

Synonyms: tribromoacetic acid ethyl ester

Formula:  $\text{CBr}_3\text{COOC}_2\text{H}_5$

Formula Weight: 324.8

Boiling Point: 225° C. (at 760 mm.)

Specific Gravity: 2.230(20/20)

Solubility:

insoluble in water     $\infty$  (in alcohol)  
     $\infty$  (in ether)

#### ETHYL TRICHLOROACETATE

Synonyms: trichloroacetic acid ethyl ester

Formula:  $\text{CCl}_3\text{COOC}_2\text{H}_5$

Formula Weight: 191.5

Boiling Point: 167 to 168° C. (at 760 mm.)

Specific Gravity: 1.383(20/4)

Solubility:

insoluble in water     $\infty$  (in alcohol)  
     $\infty$  (in ether)

#### ETHYL TRIETHYLSILICYL OXIDE

Synonyms: triethyl silicol ethyl ether

Formula:  $(\text{C}_2\text{H}_5)_3\text{S:OC}_2\text{H}_5$

Formula Weight: 160.3

Boiling Point: 153° C. (at 760 mm.)

Specific Gravity: 0.840 at 0° C.

Solubility:

insoluble in water     $\infty$  (in alcohol)  
     $\infty$  (in ether)

#### ETHYL VALERATE

Synonyms:

ethyl pentanoate        valerianic ether  
 ethyl valerate        ethyl valerianate  
 valeric acid ethyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{COOC}_2\text{H}_5$

Characteristics:

pleasant fruity odor  
 characteristic valeric taste

Formula Weight: 130.2

Melting Point: -91.2° C.

Boiling Point:

145 to 146° C. (at 760 mm.)

144.6° C. (at 737 mm.)

Specific Gravity: 0.8739(20/4)

Refractive Index: 1.40094

Viscosity (centipoises): 0.847 at 20° C.

Heat of Combustion (kilogram-calories  
 per mole): 1017.5 (liquid)

Uses:

artificial fruit essences  
 essential oils  
 medicines  
 perfumes

Solubility (grams per 100 ml.):

0.237 (in water) at 25° C.

$\infty$  (in alcohol)         $\infty$  (in ether)

#### $\alpha$ -ETHYLVALERIC ACID

Synonyms:

3-ethylpentanoic acid  
 ethylpropylacetic acid  
 3-hexanecarboxylic acid

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{COOH}$

Characteristics: oily

Formula Weight: 130.2

Boiling Point: 209.2° C. (at 760 mm.)

Uses: organic syntheses

Solubility:

insoluble in water    soluble in alcohol  
    soluble in ether

#### $\beta$ -ETHYLVALERIC ACID

Synonyms:

$\beta$ ,  $\beta$ -diethylpropionic acid  
 3-ethylpentanoic acid

Formula:  $(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{COOH}$

Characteristics: oily

Formula Weight: 130.2

Boiling Point: 212° C. (at 760 mm.)

## ETHYL VINYL ETHER

Synonyms: ethenoxyethane

Formula:  $\text{CH}_2\text{:CHOC}_2\text{H}_5$ 

Formula Weight: 72.1

Boiling Point:

35.5° C. (at 760 mm.)

35.8° C. (at 760 mm.)

Specific Gravity:

0.763(15/15) 0.755(20/20)

6.28 lbs. per gal. at 20° C.

Refractive Index: 1.3763

Uses:

organic syntheses plasticizers  
adhesives

Solubility:

very slightly soluble in water  
soluble in alcohol ∞ (in ether)

## ETHYL VINYL SULFIDE

Formula:  $\text{CH}_2\text{:CHSC}_2\text{H}_5$ 

Formula Weight: 86.2

Boiling Point:

90.5 to 91.5° C. (at 760 mm.)

Specific Gravity: 0.887 at 14° C.

4-ETHYL-m-XYLENE

Synonyms:

1-ethyl-2,4-dimethylbenzene

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{C}_2\text{H}_5$ 

Formula Weight: 134.2

Melting Point: &lt; -20° C.

Boiling Point: 185 to 186° C. (at 760 mm.)

Specific Gravity: 0.8686(20/4)

Solubility:

insoluble in water soluble in ether  
very soluble in alcohol5-ETHYL-m-XYLENE

Synonyms:

1-ethyl-3,5-dimethylbenzene

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{C}_2\text{H}_5$ 

Specific Gravity: 134.2

Melting Point: &lt; -20° C.

Boiling Point: 185° C. (at 760 mm.)

Specific Gravity: 0.861 at 20° C.

Solubility:

insoluble in water soluble in alcohol  
soluble in ether4-ETHYL-o-XYLENE

Synonyms:

4-ethyl-1,2-dimethylbenzene

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{C}_2\text{H}_5$ 

Formula Weight: 134.2

Melting Point: &lt; -20° C.

Boiling Point: 183 to 189° C. (at 760 mm.)

Specific Gravity: 0.869(20/4)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether2-ETHYL-p-XYLENE

Synonyms:

2-ethyl-1,4-dimethylbenzene

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{C}_2\text{H}_5$ 

Formula Weight: 134.2

Melting Point: &lt; -20° C.

Boiling Point: 185° C. (at 760 mm.)

Specific Gravity: 0.875 at 22° C.

Solubility:

insoluble in water soluble in ether  
slightly soluble in alcohol

## ETHYNYLBENZENE

Synonyms: phenylacetylene

Formula:  $\text{C}_6\text{H}_5\text{C}\text{:CH}$ 

Formula Weight: 102.1

Melting Point: -43° C.

Boiling Point: 142 to 143° C. (at 760 mm.)

Specific Gravity: 0.930(20/4)

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

### EUGENOL

Synonyms:

4-allylguaiacol  
4-allyl-2-methoxyphenol  
carophyllic acid  
eugenic acid  
p-oxy-m-methoxyallylbenzene

Formula:  $\text{CH}_2:\text{CHCH}_2\text{C}_6\text{H}_3(\text{OCH}_3)\text{OH}$

Formula Weight: 164.2

Melting Point: 10.3° C.

Boiling Point:

252 to 253.5° C. (at 760 mm.)

Specific Gravity:

1.0664(20/4)                      1.070(15/4)

Refractive Index: 1.5416 at 19.4° C.

Viscosity (centipoises): 6.931 at 25° C.

Uses:

essential oils  
medicines  
germicides  
manufacture of isoeugenol

Solubility:

very slightly soluble in water  
∞ (in alcohol)                      ∞ (in ether)  
very soluble in chloroform  
soluble in oils

## F

### 1-d-FENCHENE

Synonyms:

1-7, 7-dimethyl-2-methylenenor-  
camphene  
d, 1-fenchene

Formula:  $\text{C}_{10}\text{H}_{16}$

Formula Weight: 136.2

Boiling Point: 155 to 158° C. (at 760 mm.)

Specific Gravity: 0.864(20/4)

Refractive Index: 1.4724 at 19° C.

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

### d-FENCHONE

Synonyms:

d-2-fenchanone                      fenchone  
d-1, 2, 3-trimethyl-2-  
norcamphanone

Formula:  $(\text{CH}_3)_3\text{C}_6\text{H}_7\text{CO}$

Characteristics:

oily                      camphor-like odor

Formula Weight: 152.2

Melting Point: 5 to 6° C.

Boiling Point:

191.0° C. (at 760 mm.)  
193 to 195° C. (at 760 mm.)  
190 to 210° C. (at 760 mm.)

Specific Gravity:

0.948 at 20° C.                      0.9465 at 19° C.  
0.9460(20/4)  
7.89 lbs. per gal. at 20° C.

Refractive Index:

1.4647 at 14.5° C.    1.4647 at 20° C.

Solubility (grams per 100 ml.):

0.5 (of water) at 20° C.  
0.2 (in water) at 20° C.  
very soluble in alcohol  
very soluble in ether

d-FENCHONE (Cont.)

## Additional Data:

coefficient of expansion,

0.00088 at 10 to 30°C.

dilution ratios,

with xylene . . . . . 2.9

with mineral spirits . . . . . 0.8

m-FLUOROANILINE

Synonyms: 1-amino-3-fluorobenzene

Formula:  $\text{FC}_6\text{H}_4\text{NH}_2$ 

Characteristics: pale yellow

Formula Weight: 111.1

Boiling Point: 186.1°C. (at 760 mm.)

Specific Gravity: 1.1561 at 18.5°C.

Refractive Index: 1.54528 at 18.5°C.

## Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

o-FLUOROANILINE

Synonyms: 1-amino-2-fluorobenzene

Formula:  $\text{FC}_6\text{H}_4\text{NH}_2$ 

Characteristics: pale yellow

Formula Weight: 111.1

Melting Point: -28.95°C.

Boiling Point: 175°C. (at 760 mm.)

Specific Gravity: 1.1437 at 18°C.

Refractive Index: 1.54672 at 18°C.

## Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

p-FLUOROANILINE

Synonyms: 1-amino-4-fluorobenzene

Formula:  $\text{FC}_6\text{H}_4\text{NH}_2$ 

Characteristics:

pale yellow                      oily

Formula Weight: 111.1

Melting Point: -0.82°C.

Boiling Point: 187.6°C. (at 760 mm.)

Specific Gravity: 1.1725(20/4)

Refractive Index: 1.53945

p-FLUOROANISOLEFormula:  $\text{FC}_6\text{H}_4\text{OCH}_3$ 

Formula Weight: 126.1

Melting Point: -43.5°C.

Boiling Point: 156 to 157°C. (at 760 mm)

## FLUOROBENZENE

Synonyms: phenyl fluoride

Formula:  $\text{C}_6\text{H}_5\text{F}$ 

Characteristics: benzene odor

Formula Weight: 96.1

Melting Point:

-41.9°C.

-42.1°C.

Boiling Point:

84.85°C. (at 760 mm.)

82 to 86°C. (at 760 mm.)

Specific Gravity: 1.024(20/4)

Refractive Index:

1.4646 at 22.8°C.      1.4677

Viscosity (centipoises):

0.752 at 0.2°C.

0.325 at 80.9°C.

0.585 at 19.9°C.

Heat of Combustion (kilogram-calories per mole): 747.2 (liquid)

Solubility (grams per 100 ml.):

0.154 (in water) at 20°C.

∞ (in alcohol)

∞ (in ether)

## Additional Data:

critical temperature, 286.5°C.

critical pressure, 44.7 atm.

## 1-FLUOROBUTANE

Synonyms: n-butyl fluorideFormula:  $\text{CH}_3(\text{CH}_2)_3\text{F}$

Formula Weight: 76.1

Boiling Point: 31.95° C. (at 760 mm.)

Specific Gravity: 0.7761

Refractive Index: 1.3419 at 15° C.

Solubility:

insoluble in water

very soluble in alcohol

## 2-FLUOROETHANOL

Synonyms:

ethylene fluorohydrin

β-fluoroethyl alcohol

Formula: CH<sub>2</sub>FCH<sub>2</sub>OH

Formula Weight: 64.1

Melting Point: 26.45° C.

Boiling Point: 103.35° C. (at 760 mm.)

Specific Gravity: 1.1112 at 18.3° C.

Refractive Index: 1.36470 at 18.4° C.

Solubility:

∞ (in water) ∞ (in ether)

∞ (in alcohol)

## 1-FLUORO-4-IODOBENZENE

Synonyms: p-fluoriodobenzene

Formula: FC<sub>6</sub>H<sub>4</sub>I

Formula Weight: 222.0

Melting Point:

-27° C.

-18° C.

Boiling Point: 183.2° C. (at 760 mm.)

Solubility:

insoluble in water soluble in alcohol

soluble in ether

## 1-FLUORONAPHTHALENE

Synonyms:

α-fluoronaphthalene

naphthyl fluoride

Formula: C<sub>10</sub>H<sub>7</sub>F

Formula Weight: 146.2

Melting Point:

-13° C.

-8° C.

Boiling Point: 212 to 216° C. (at 760 mm.)

Specific Gravity: 1.1340

Refractive Index: 1.59389 at 19.5° C.

Solubility:

insoluble in water

soluble in alcohol, ether, benzene, and

acetone

## 1-FLUORO-2-NITROBENZENE

Formula: FC<sub>6</sub>H<sub>4</sub>NO<sub>2</sub>

Characteristics: yellow

Formula Weight: 141.1

Melting Point: -6° C.

Boiling Point: 214.8° C. (at 760 mm.)

Specific Gravity: 1.3375 at 17.2° C.

Refractive Index: 1.54886

Solubility:

insoluble in water soluble in alcohol

soluble in ether

## 1-FLUORO-3-NITROBENZENE

Formula: FC<sub>6</sub>H<sub>4</sub>NO<sub>2</sub>

Characteristics: yellow

Formula Weight: 141.1

Melting Point: 3.6° C.

Boiling Point: 200.16° C. (at 760 mm.)

Specific Gravity: 1.3254 at 19° C.

Refractive Index: 1.53622 at 19° C.

Solubility:

insoluble in water soluble in alcohol

soluble in ether

## 1-FLUOROOCCTANE

Synonyms: octyl fluoride

Formula: CH<sub>3</sub>(CH<sub>2</sub>)<sub>6</sub>CH<sub>2</sub>F

Formula Weight: 132.2

## 1-FLUOROOCTANE (Cont.)

Boiling Point: 142.5° C. (at 754 mm.)

Specific Gravity: 0.804 at 21° C.

Solubility: insoluble in water

## 1-FLUOROPENTANE

Synonyms: n-amyl fluorideFormula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{F}$ 

Formula Weight: 90.1

Melting Point: -80° C.

Boiling Point: 62.8° C. (at 760 mm.)

Specific Gravity: 0.7880

Refractive Index: 1.35622

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

o-FLUOROSTYRENE

Synonyms: 1-fluoro-2-vinylbenzene

Formula:  $\text{FC}_6\text{H}_4\text{CH}:\text{CH}_2$ 

Formula Weight: 122.1

Boiling Point: 32 to 34° C. (at 3 mm.)

Specific Gravity: 1.030

Refractive Index: 1.5197

Solubility:

insoluble in water      soluble in alcohol

soluble in ether

m-FLUOROSTYRENE

Synonyms: 1-fluoro-3-vinylbenzene

Formula:  $\text{FC}_6\text{H}_4\text{CH}:\text{CH}_2$ 

Formula Weight: 122.1

Boiling Point: 30 to 31° C. (at 4 mm.)

Specific Gravity: 1.025

Refractive Index: 1.5173

Solubility:

insoluble in water      soluble in alcohol

soluble in ether

p-FLUOROSTYRENE

Synonyms: 1-fluoro-4-vinylbenzene

Formula:  $\text{FC}_6\text{H}_4\text{CH}:\text{CH}_2$ 

Formula Weight: 122.1

Boiling Point: 29 to 30° C. (at 4 mm.)

Specific Gravity: 1.024

Refractive Index: 1.5158

Solubility:

insoluble in water      soluble in alcohol

soluble in ether

d-FLUOROTOLUENE

Synonyms: benzyl fluoride

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{F}$ 

Formula Weight: 110.1

Melting Point: -35° C.

Boiling Point: 139.9° C. (at 760 mm.)

Specific Gravity: 1.02278 at 25.3° C.

Uses: organic syntheses

Solubility: decomposes in water

m-FLUOROTOLUENE

Synonyms: 3-fluorotoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{F}$ 

Formula Weight: 110.1

Melting Point: -110.8° C.

Boiling Point: 115 to 116° C. (at 760 mm.)

Specific Gravity: 0.9972 at 18° C.

Refractive Index: 1.4691

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

o-FLUOROTOLUENE

Synonyms: 2-fluorotoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{F}$

Formula Weight: 110.1

Melting Point:  $-80^{\circ}\text{C}$ .

Boiling Point:  $114$  to  $116^{\circ}\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.0041 at  $18^{\circ}\text{C}$ .

Refractive Index: 1.4704

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

### p-FLUOROTOLUENE

Synonyms: 4-fluorotoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{F}$

Formula Weight: 110.1

Boiling Point:  $116$  to  $117^{\circ}\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.001 at  $15^{\circ}\text{C}$ .

Refractive Index: 1.470

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

### FORMALDEHYDE

(A  $40$  to  $42\%$  by volume solution in water)

Synonyms:

formalin	formol
formalith	oxymethylene
formic aldehyde	

Formula:  $\text{HCHO}$  solution

Formula Weight: 30.0

Melting Point (gas):  $-92^{\circ}\text{C}$ .

Boiling Point (gas):  $-21^{\circ}\text{C}$ . (at  $760$  mm.)

Specific Gravity (gas): 0.815 at  $-20^{\circ}\text{C}$ .

Heat of Combustion (kilogram-calories per mole): 134.1 (gas)

Uses:

in preparation and manufacture of anthracene and quinoline dyes, acridine, auramine, adhesives, cellulose esters, dextrans, disinfectants, germicides and preservatives,

dye intermediates, embalming fluids, explosives, formals, formic acid, hexamethylenetetramine, various other organic compounds, rayon, synthetic gums, resins and resin lacquers, fungicide, fur and leather processing, gelatinizing agent, insolubilizing agent for casein plastics, metallurgy, mirror silvering, photographic developing and hardening agent, plant disease treatment, reducing agent in gold and silver recovery, silk bleaching and weighting, textile dyeing and mordanting, waterproofing paper, straw hats, and textiles, yeast stimulant

Solubility:

soluble in water, alcohol, and ether

### FORMALDEHYDE OXIME

Synonyms:

formaldoxime                      formoxime

Formula:  $\text{HCN:NOH}$

Formula Weight: 45.0

Boiling Point:  $84^{\circ}\text{C}$ . (at  $760$  mm.)

Solubility (grams per 100 ml.):  
 $10$  to  $20$  (in water)

### FORMAMIDE

Synonyms: methanamide

Formula:  $\text{HCONH}_2$

Characteristics: oily

Formula Weight: 45.0

Melting Point:  $2.55^{\circ}\text{C}$ .

Boiling Point:

$210.7^{\circ}\text{C}$ . (at  $760$  mm.) decomposes  
 $193^{\circ}\text{C}$ . (at  $760$  mm.)  
 $92$  to  $95^{\circ}\text{C}$ . (at  $10$  mm.)

Specific Gravity:

1.134(20/4)                      1.1292(25/4)

Refractive Index:

1.44530 at  $22.7^{\circ}\text{C}$ .    1.447

## FORMAMIDE (Cont.)

Heat of Combustion (kilogram-calories per mole): 134.9 (solid)

## Uses:

organic syntheses    anti-freeze

## Solubility:

$\infty$  (in water)             $\infty$  (in alcohol)  
slightly soluble in ether and benzene  
soluble in glycerol

## FORMIC ACID

Synonyms: methanoic acid

Formula: HCOOH

## Characteristics:

characteristic, pungent, penetrating  
odor  
fumes

Formula Weight: 46.0

## Melting Point:

8.40°C.                      8.6°C.

Boiling Point: 100.7°C. (at 760 mm.)

## Specific Gravity:

1.22647(15/4)            1.220(20/4)

Refractive Index: 1.37137

## Surface Tension (dynes per cm.):

38.7 at 10°C.            29.0 at 100°C.  
37.6 at 20°C.

## Viscosity (centipoises):

2.2469 at 10°C.            0.780 at 70°C.  
1.784 at 20°C.            0.549 at 100°C.  
1.219 at 40°C.

Flash Point: 156°F. (closed)

Heat of Vaporization (gram-calories per g.): 120.0 at 15°C.

Heat of Fusion (gram-calories per g.): 58.9 at 15°C.

Heat of Combustion (kilogram-calories per mole): 62.8 (liquid)

## Uses:

organic syntheses  
solvent for electroplating, lacquers,  
and perfumes  
textile finishing

## Solubility:

$\infty$  (in water)             $\infty$  (in ether)  
 $\infty$  (in alcohol)             $\infty$  (in glycerol)

## Additional Data:

pH of 1% solution, 2.15  
acid number, 1219.6  
vapor density, 1.59

## 2-FURALDEHYDE

## Synonyms:

artificial oil of ants  
2-furancarboxaldehyde  
fural  
furfurancarboxylic aldehyde  
furfural  
furfuraldehyde  
furol  
furole  
furfurole  
pyromucic aldehyde

Formula: C4H3OCHO

## Characteristics:

colorless to yellow amber  
almond odor            oily  
mobile            spicy flavor  
bitter somewhat sharp taste

Formula Weight: 96.1

Melting Point: -36.5°C.

## Boiling Point:

161.7°C. (at 760 mm.)  
110 to 169°C. (at 760 mm.)  
157 to 167°C. (at 760 mm.)

## Specific Gravity:

1.1598(20/4)            1.161 at 20°C.  
9.678 lbs. per gal. at 20°C.

Refractive Index: 1.52608

## Surface Tension (dynes per cm.):

43.5 at 20°C.            25.4 at 160°C.  
40.9 at 40°C.

## Viscosity (centipoises):

1.49 at 25°C.            1.35 at 38°C.  
1.09 at 54°C.            0.68 at 99°C.

Inflammability Range (volume per cent in air): 2.1 (lower limit)

Flash Point:  
    155° F. (open)            140° F. (closed)

Heat of Vaporization:  
    10,321 gram-calories per mole  
    at 160 to 166° C.  
    107.5 gram-calories per g. at 15° C.

Heat of Combustion (kilogram-calories  
per mole): 560.3 (liquid)

Uses:  
    selective solvent in the purification of  
    butadiene, lubricating oils, wood  
    rosin, and tall oil and sulfate  
    turpentine  
    solvent for extraction of acetic acid  
    and glyceride oils  
    solvent for coating materials, dyes,  
    gums, resins, paints, nitrocellulose,  
    and cellulose acetate  
    wetting agent

Solubility (grams per 100 ml.):  
    4.8 (of water)  
    8.3 (in water) at 20° C.  
    ∞ (in alcohol)            ∞ (in butyl  
    ∞ (in ether)            acetate)  
    ∞ (in acetone)        ∞ (in china wood  
    ∞ (in benzol)        oil)  
    miscible with most organic solvents  
    except petroleum hydrocarbons and  
    glycerol

Additional Data:  
    dielectric constant, 38 at 25° C.  
    ignition temperature, 739° F.  
    vapor density, 3.31  
    turns reddish brown when exposed to  
    light and air  
    coefficient of expansion,  
    0.00087 at 10 to 30° C.  
    dilution ratio,  
    with xylene . . . . . 1.6

FURAN

Synonyms:  
    furfuran                    furfurane

Formula: CH:CHCH:CHO

Formula Weight: 68.1

Boiling Point:  
    32° C. (at 758 mm.)  
    31.3° C. (at 760 mm.)

Specific Gravity:  
    0.9444 at 15° C.        0.9366(20/4)

Refractive Index:  
    1.42157                    1.4214

Flash Point: <32° F. (closed)

Specific Heat (gram-calories per mole  
per ° C., vapor):  
    17.21 at 44.33° C.    20.3 at 98.99° C.  
    18.61 at 67.71° C.

Heat of Vaporization (gram-calories  
per g.):  
    95.5 at 31.2° C.        95.3 at 15° C.

Heat of Combustion (kilogram-calories  
per mole at constant volume):  
    500.1 (liquid)

Solubility:  
    insoluble in water  
    very soluble in alcohol  
    very soluble in ether  
    soluble in common organic solvents

Additional Data:  
    molecular heat of formation,  
    14.8 kilogram-calories  
    keep away from heat and open flames  
    use with adequate ventilation  
    avoid prolonged or repeated breathing  
    of vapors or contact with the skin

FURFURYL ACETATE

Synonyms: acetic acid furfuryl ester

Formula: C<sub>4</sub>H<sub>3</sub>OCH<sub>2</sub>OOCCH<sub>3</sub>

Characteristics: mild pleasant odor

Formula Weight: 140.1

Boiling Point:  
    180 to 186° C. (at 760 mm.)  
    175 to 177° C. (at 764 mm.)  
    84 to 85° C. (at 25 mm.)

Vapor Pressure (mm. Hg): 1 at 30° C.

## FURFURYL ACETATE (Cont.)

## Specific Gravity:

1.1175(20/4)                      1.119 at 20° C.  
                     8.92 lbs. per gal. at 20° C.

Refractive Index: 1.4603 at 25° C.

Flash Point: 185° F. (closed)

## Solubility:

insoluble in water  
 water is insoluble in this compound  
 soluble in alcohol      soluble in ether

## Additional Data:

turns brown when exposed to air and  
 light  
 coefficient of expansion,  
 0.00094 at 10 to 30° C.  
 dilution ratio,  
 with xylene . . . . . 13

## FURFURYL ALCOHOL

## Synonyms:

2-furan carbinol      furfuralcohol  
 2-furanmethanol      d-furylcarbinol  
 2-hydroxymethylfuran

Formula:  $C_4H_3OCH_2OH$ 

## Characteristics:

colorless to yellow-amber  
 nearly odorless

Formula Weight: 98.1

Melting Point: -31° C.

## Boiling Point:

170.0 to 171° C. (at 750 mm.)  
 168 to 171° C. (at 760 mm.)  
 167 to 173° C. (at 760 mm.)  
 152 to 220° C. (at 760 mm.)

## Specific Gravity:

1.1296(20/4)                      1.130(25/25)  
                     9.46 lbs. per gal. at 20° C.

## Refractive Index:

1.4850 at 26° C.                      1.484 at 25° C.  
 1.4852 at 23° C.

Flash Point: 175° F. (closed)

## Uses:

solvent for dyes, resins, and  
 nitrocellulose  
 penetrants  
 wetting agents  
 synthetic resins

## Solubility:

$\infty$  (of water)                       $\infty$  (in alcohol)  
 $\infty$  (in water)                       $\infty$  (in ether)  
 soluble in chloroform  
 soluble in benzene  
 immiscible with paraffin petroleum  
 hydrocarbons

## Additional Data:

coefficient of expansion,  
 0.00077 at 10 to 30° C.  
 dilution ratios,  
 with xylene . . . . . 1.5  
 with mineral spirits . . . . . -

## FURFURYLAMINE

Synonyms: 2-furanmethylaniline

Formula:  $C_6H_3OCH_2NH_2$ 

Formula Weight: 97.1

Boiling Point: 144 to 146° C. (at 760 mm.)

Specific Gravity: &lt;1

## Solubility:

$\infty$  (in water)  
 soluble in alcohol      soluble in ether

## Additional Data:

autoignition temperature, 915° F.  
 vapor density, 3.37

## FURFURYL BUTYRATE

Synonyms: butyric acid furfuryl ester

Formula:  $C_4H_3OCH_2OOC C_3H_7$ 

Formula Weight: 168.2

## Boiling Point:

212 to 213° C. (at 764 mm.)  
 69 to 70° C. (at 1 mm.)

Specific Gravity: 1.0530(20/4)

## Solubility:

very slightly soluble in water  
 soluble in alcohol      soluble in ether

## FURFURYL ETHER

## Synonyms:

difurfuryl ether  
di-d-furfuryl ether

Formula:  $(C_4H_3O.CH_2)_2O$

Characteristics: hygroscopic

Formula Weight: 178.2

## Boiling Point:

88 to 89° C. (at 1 mm.)  
101° C. (at 2 mm.)

## Specific Gravity:

1.1405                      1.137(20/0)

Refractive Index: 1.5088

## Solubility:

insoluble and decomposes in water

## Additional Data:

darkens when exposed to air

## FURFURYL PROPIONATE

## Synonyms:

propionic acid furfuryl ester

Formula:  $C_4H_3OCH_2OCC_2H_5$

Formula Weight: 154.2

Boiling Point: 195 to 196° C. (at 762 mm.)

Specific Gravity: 1.1085(20/4)

## Solubility:

very slightly soluble in water  
soluble in alcohol    ∞ (in ether)

## FUROYL CHLORIDE

## Synonyms:

furoic acid chloride  
2-furoyl chloride  
pyromucyl chloride

Formula:  $C_4H_3OCOC_1$

Formula Weight: 130.5

Melting Point: 0° C.

## Boiling Point:

173 to 176° C. (at 760 mm.)  
59.5 to 61.5° C. (at 7 mm.)

Uses: disinfecting grain elevators

## Solubility:

decomposes in hot water  
decomposes in hot alcohol  
soluble in ether

Additional Data: lachrymator

## 2-FURYLMETHANETHIOL

Synonyms: furfuryl mercaptan

Formula:  $C_4H_3OCH_2SH$

Characteristics: oily

Formula Weight: 114.2

## Boiling Point:

155° C. (at 760 mm.)  
84° C. (at 65 mm.)

Specific Gravity: 1.1319(20/4)

Refractive Index: 1.5329

Solubility: insoluble in alcohol

## FURYLNITRILE

Synonyms: 2-cyanofuran

Formula:  $C_4H_3OCN$

Formula Weight: 93.1

Boiling Point: 146 to 148° C. (at 760 mm.)

## Solubility:

very slightly soluble in water  
∞ (in alcohol)            ∞ (in ether)

## FUSEL OIL

## Synonyms:

fermentation amyl alcohol  
grain oil  
potato oil  
potato spirit

## Formula:

a mixture consisting chiefly of normal and isoamyl alcohols together with smaller amounts of ethyl, propyl, butyl, hexyl, heptyl, and other alcohols

## FUSEL OIL (Cont.)

## Characteristics:

oily	toxic
volatile	disagreeable odor

## Uses:

organic syntheses	lacquers
analytical reagent	perfumes
pharmaceuticals	varnishes
artificial fruit syrups	
nitrocellulose plastics	

## Solubility:

soluble in water	soluble in ether
soluble in alcohol	

## FUSEL OIL crude

Boiling Point: 122 to 138° C. (at 760 mm.)

## Specific Gravity:

0.8315(20/20)  
6.92 lbs. per gal. at 20° C.

## Uses:

solvent for plastics  
 resins

## Solubility:

9% (in saturated sodium chloride solution)

## FUSEL OIL refined

Characteristics: non-residual odor

Boiling Point: 110 to 135° C. (at 760 mm.)

## Specific Gravity:

0.811 to 0.8115(20/20)  
6.76 lbs. per gal. at 20° C.

Flash Point: 123° F. (open)Solubility (cc. in 100 cc. of solvent):  
9.9 (of water)

## Additional Data:

coefficient of expansion,  
0.00051 per ° F.    0.00092 per ° C.

Evaporation Rate at 95° F. (in minutes)

%	Minutes
5	<u>3 1/2</u>
25	<u>17</u>
50	<u>36 1/2</u>
75	<u>64 1/4</u>
90	<u>90 1/4</u>
95	<u>103 1/2</u>

## G

## GASOLINE

## Synonyms:

motor spirit	petrol
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## Formula:

distillation product of crude petroleum

Melting Point: -46° C.Boiling Point: 38 to 204° C. (at 760 mm.)Specific Gravity: 0.75

Inflammability Range (volume per cent in air):

1.3 (lower limit)    6 (upper limit)

Flash Point: -50° F. (closed)

## Uses:

solvent	cleaning fluid
fluid for internal combustion engines	
rubber cements	

## Additional Data:

autoignition temperature, 495° F.  
 vapor density, 3 to 4  
 see also pentane, hexane, heptane, octane, etc.

## GERANIC ACID

## Synonyms:

3, 7-dimethyl-2, 6(and 2, 7)-  
octadienoic acid

Formula:  $C_{10}H_{16}O_2$

Characteristics: oily

Formula Weight: 168.2

Boiling Point: 119° C. (at 20 mm.)

Specific Gravity: 0.952(20/4)

Refractive Index: 1.4870

## Solubility:

insoluble in water      soluble in alcohol  
   soluble in ether

## GERANIOL

## Synonyms:

3, 7-dimethyl-2, 6-octadien-1-ol  
2, 6-dimethyl-2, 6-octadiene-8-ol

Formula:  $C_{10}H_{17}OH$

## Characteristics:

oily  
sweet odor of roses  
odor and taste varies with source

Formula Weight: 154.3

Melting Point: < -15° C.

## Boiling Point:

229 to 231° C. (at 760 mm.)  
120 to 122° C. (at 17 mm.)

## Specific Gravity:

0.8812(16/4)      0.889(20/4)

Refractive Index: 1.4798

## Uses:

rose and other perfumes  
apple, apricot, peach, pear, pineapple,  
plum, raspberry, and strawberry  
flavors

## Solubility:

insoluble in water      soluble in alcohol  
   soluble in ether

## Solubility in Alcohol-Water Mixtures

% Alcohol	Ratio
50	1:13
60	2:15
70	2:7
96	1:1

## GERANYL ACETATE

## Synonyms:

acetic acid geranyl ester  
geraniol acetate

Formula:  $CH_3COOC_{10}H_{17}$

## Characteristics:

gooseberry aroma  
bitter, somewhat insipid taste  
sweetish      fragrant

Formula Weight: 196.3

## Boiling Point:

243.3° C. (at 760 mm.) decomposes  
242 to 245° C. (at 764 mm.) decomposes

Specific Gravity: 0.917(15/4)

## Refractive Index:

1.4660      1.4628 at 15° C.

## Uses:

shading synthetic apple, apricot,  
banana, currant, gooseberry, grape,  
lemon, honey, peach, and raspberry  
flavor

## Solubility:

very slightly soluble in water  
soluble in alcohol    ∞ (in ether)  
one volume dissolves in 800 volumes  
of 45% alcohol and in 7 to 10 volumes  
of 70% alcohol

## GERANYL BUTYRATE

## Synonyms:

butyric acid geranyl ester  
geraniol butyrate

Formula:  $CH_3(CH_2)_2COOC_{10}H_{17}$

## Characteristics:

fragrant  
characteristic rose odor  
apricot flavor      sweet taste



## GLYCEROL

## Synonyms:

glycerin  
glycyl alcohol  
propenyl alcohol  
trihydroxypropane

Formula:  $\text{CH}_2\text{OHCHOHCH}_2\text{OH}$

## Characteristics:

pale yellow                      warm, sweet taste  
syrupe                              hygroscopic

Formula Weight: 92.1

Melting Point:  $17.9^\circ\text{C}$ .

## Boiling Point:

$290^\circ\text{C}$ . (at 760 mm.)  
 $263.0^\circ\text{C}$ . (at 400 mm.)  
 $240.0^\circ\text{C}$ . (at 200 mm.)  
 $220.0^\circ\text{C}$ . (at 100 mm.)  
 $208.0^\circ\text{C}$ . (at 60 mm.)  
 $182.2^\circ\text{C}$ . (at 20 mm.)  
 $167.2^\circ\text{C}$ . (at 10 mm.)  
 $125.5^\circ\text{C}$ . (at 1 mm.)

Specific Gravity: 1.260(20/4)

Refractive Index: 1.1473

## Surface Tension (dynes per cm.):

63 at  $20^\circ\text{C}$ .                      52 at  $150^\circ\text{C}$ .  
59 at  $90^\circ\text{C}$ .

## Viscosity (centipoises):

4220 at  $2.8^\circ\text{C}$ .                      830 at  $20.3^\circ\text{C}$ .  
2518 at  $8.1^\circ\text{C}$ .                      777.6 at  $20.9^\circ\text{C}$ .  
1387 at  $14.3^\circ\text{C}$ .                      494 at  $26.5^\circ\text{C}$ .  
1069 at  $20^\circ\text{C}$ .

## Flash Point:

$350^\circ\text{F}$ . (open)                       $320^\circ\text{F}$ . (closed)

## Heat of Fusion (gram-calories per g.):

47.5 at  $15^\circ\text{C}$ .

## Heat of Combustion (kilogram-calories per mole): 397.0 (liquid)

## Uses:

solvent for some coal tar dyes, anti-freeze, explosives, flavors, pharmaceuticals, preservatives, and softeners  
humectant  
moistening agent

mold preservative

for a complete list of uses see

"Nothing Takes the Place of Glycerine" published by the Glycerine Producers Association

## Solubility:

$\infty$  (in water)                       $\infty$  (in alcohol)  
insoluble in ether  
insoluble in chloroform  
insoluble in benzene  
miscible with propylene glycol  
one volume dissolves in 11 volumes of ethyl acetate  
not very soluble in many organic solvents

## Additional Data:

solidifies below  $17.9^\circ\text{C}$ .  
autoignition temperature,  $739^\circ\text{F}$ .  
vapor density, 3.17

## Specific Gravity of Glycerol-Water (w/w) Solutions

Glycerol %	Specific Gravity
95	1.25270(15/15)
95	1.25245(15.5/15.5)
95	1.25075(20/20)
95	1.24910(25/25)
90	1.23950(15/15)
90	1.23920(15.5/15.5)
90	1.23755(20/20)
90	1.23585(25/25)
80	1.213(15/15)
70	1.185(15/15)
60	1.157(15/15)
50	1.129(15/15)
40	1.101(15/15)
30	1.074(15/15)
20	1.049(15/15)
10	1.023(15/15)
5	1.012(15/15)

GLYCEROL  $\alpha$ -BUTYL ETHER

Formula:  $\text{CH}_2\text{OHCHOHCH}_2\text{OC}_4\text{H}_9$

Formula Weight: 148.2

Boiling Point:  $133$  to  $137^\circ\text{C}$ . (at 18 mm.)

Specific Gravity: 0.945(25/25)

## Solubility:

soluble in water                       $\infty$  (in alcohol)  
 $\infty$  (in ether)

GLYCEROL  $\alpha, \gamma$ -DIBUTYL ETHERFormula:  $(C_4H_9OCH_2)_2CHOH$ 

Formula Weight: 204.3

Boiling Point: 121 to 125° C. (at 13 mm.)

Solubility:

insoluble in water	$\infty$ (in alcohol)
	$\infty$ (in ether)

## GLYCEROL DIFORMATE

Formula:  $(HCOO)_2C_3H_6O$ 

Formula Weight: 148.1

Boiling Point: 163 to 166° C. (at 30 mm.)

Specific Gravity: 1.304 at 15° C.

Solubility: insoluble in carbon disulfide

GLYCEROL  $\alpha, \gamma$ -DIISOAMYL ETHERFormula:  $(C_5H_{11}OCH_2)_2CHOH$ 

Formula Weight: 232.4

Boiling Point: 270 to 272° C. (at 760 mm.)

Specific Gravity: 0.903(25/25)

Solubility:

insoluble in water	$\infty$ (in alcohol)
	$\infty$ (in ether)

GLYCEROL  $\alpha, \gamma$ -DIMETHYL ETHERFormula:  $(CH_3OCH_2)_2CHOH$ 

Formula Weight: 120.2

Boiling Point: 169° C. (at 760 mm.)

Specific Gravity: 1.004(25/4)

Solubility:

$\infty$ (in water)	$\infty$ (in ether)
$\infty$ (in alcohol)	

## GLYCEROL 1,2-DINITRATE

Formula:  $C_3H_3(OH)(ONO_2)_2$ 

Characteristics: oily

Formula Weight: 182.1

Melting Point: explodes

Solubility:

decomposes in acids
decomposes in alkalies

## GLYCEROL 1,3-DINITRATE

Formula:  $CHOH(CH_2ONO_2)_2$ 

Characteristics: oily

Formula Weight: 182.1

Melting Point: &lt; -30° C. explodes

Boiling Point:

146 to 148° C. (at 15 mm.)
slight decomposition

Specific Gravity: 1.47 at 15° C.

Solubility:

very soluble in alcohol
very soluble in ether
decomposes in acids
decomposes in alkalies

## GLYCEROL ETHER

Formula:  $C_3H_5O_3:C_3H_5$ 

Formula Weight: 130.1

Boiling Point: 171 to 172° C. (at 760 mm.)

Specific Gravity: 1.091 at 18° C.

Solubility:

$\infty$ (in water)	$\infty$ (in ether)
$\infty$ (in alcohol)	

## GLYCEROL FURFURAL

Formula:  $C_5H_4O:C_3H_6O_3$ 

Characteristics: yellow

Formula Weight: 170.2

Boiling Point: 163 to 167° C. (at 22 mm.)

Specific Gravity: 1.267(25/25)

Solubility:

soluble in water	$\infty$ (in alcohol)
slightly soluble in ether	

GLYCEROL  $\alpha$ -ISOAMYL ETHERFormula:  $\text{CH}_2\text{OHCHOHCH}_2\text{OC}_5\text{H}_{11}$ 

Formula Weight: 162.2

Boiling Point: 260 to 262°C. (at 760 mm.)

Specific Gravity: 0.987

Solubility:

soluble in water  $\infty$  (in alcohol)  
soluble in etherGLYCEROL  $\alpha$ -METHYL ETHERFormula:  $\text{CH}_3\text{OC}_3\text{H}_5(\text{OH})_2$ 

Formula Weight: 106.1

Boiling Point: 220°C. (at 760 mm.)

Specific Gravity: 1.111(25/4)

Solubility:

 $\infty$  (in water) soluble in ether  
 $\infty$  (in alcohol)

## GLYCEROL TRINITRITE

Formula:  $\text{C}_3\text{H}_5(\text{ONO})_3$ 

Characteristics: yellow

Formula Weight: 179.1

Boiling Point:

150°C. (at 760 mm.)  
slight decomposition

Specific Gravity: 1.291(10/16)

Solubility:

decomposes in water  
decomposes in alcohol  
soluble in ether  
soluble in chloroform  
soluble in benzene  
insoluble in carbon disulfide

## GLYCEROPHOSPHORIC ACID

Synonyms:

glycerinophosphoric acid  
glycerolphosphoric acidFormula:  $\text{C}_3\text{H}_5(\text{OH})_2\text{H}_2\text{PO}_4$ 

Characteristics:

colorless to pale yellow  
oily

Formula Weight: 172.1

Melting Point: -20°C.

Specific Gravity:

1.59(14/4) 1.125

Uses:

medicines glycerophosphates

Solubility:

 $\infty$  (in water)  $\infty$  (in alcohol)

## GLYCIDOL

Synonyms:

epihydric alcohol  
epihydrin alcohol  
2, 3-epoxy-1-propanol  
glycideFormula:  $\text{CH}_2\text{OCHCH}_2\text{OH}$ 

Formula Weight: 74.1

Boiling Point:

166 to 167°C. (at 760 mm.)  
slight decomposition

Specific Gravity:

1.165(0/4) 1.114(16/16)

Solubility:

 $\infty$  (in water)  $\infty$  (in ether)  
 $\infty$  (in alcohol) soluble in benzene  
slightly soluble in petroleum  
slightly soluble in xylene

## GLYCOL

Synonyms:

1, 2-ethanediol glycohol alcohol  
ethylene alcohol glycol alcohol  
ethylene glycolFormula:  $\text{CH}_2\text{OHCH}_2\text{OH}$ 

Characteristics:

syrupe sweet taste  
nearly odorless mild odor

Formula Weight: 62.1

GLYCOL (Cont.) EG

## Melting Point:

-17.4° C.                      -15.6° C.  
-12° C.

## Boiling Point:

197.2° C. (at 760 mm.)  
198 to 200° C. (at 760 mm.)  
190 to 210° C. (at 760 mm.)  
123° C. (at 50 mm.)

## Specific Gravity:

1.1155(20/4)                      1.111(25/25)  
1.113(19/4)                      1.118(15.6/15.6)  
1.113(77/77)° F.  
9.3 lbs. per gal. at 20° C.

## Refractive Index:

1.4274                      1.4308 at 25° C.

## Surface Tension (dynes per cm.):

49 at 0° C.                      52.5 at 25° C.  
47.7 at 20° C.                      42.3 at 80° C.

## Viscosity (poises):

0.26 at 15° C.                      0.17 at 25° C.  
0.21 at 20° C.

## Flash Point:

240° F. (open)                      232° F. (closed)

## Specific Heat (gram-calories per g. per ° C.):

0.537 at -9.8° C.                      0.556 at 5.2° C.  
0.571 at 15° C.                      0.575 at 20° C.

## Heat of Vaporization (gram-calories per g.):

235.5 at 130.6° C.                      210.3 at 188.4° C.  
282.2 at 160.3° C.                      191 at 177° C.

## Heat of Fusion (gram-calories per g.):

44.76                      43.3

## Heat of Combustion (gram-calories per mole):

282,200 at constant pressure (liquid)  
281,400 at constant volume (liquid)

## Uses:

motor coolant                      radiator antifreeze  
solvent for dyes, waxes, drugs, and resins  
solvent mixtures for cellulose esters and ethers, lacquers, varnishing rubs, and stains

leather and textile processing  
moistening agent for leather, tobacco  
glycerine substitute  
softening agent  
organic syntheses  
nonfreezing explosives

## Solubility:

∞ (of water)                      ∞ (in alcohol)  
∞ (in water)                      soluble in ether  
insoluble in carbon tetrachloride

## Additional Data:

extremely hygroscopic  
coefficient of expansion,  
0.00102 per ° F.                      0.00057 per ° C.  
autoignition temperature, 775° C.  
vapor density, 2.14  
electrical conductivity,  
1.07 x 10<sup>-6</sup> mhos at 25° C.  
pour point, none  
fire point, open cup, 245° F.

## GLYCOL DIBENZYL ETHER

Formula: (C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>OCH<sub>2</sub>)<sub>2</sub>

Formula Weight: 242.3

Boiling Point: 131 to 136° C. (at 2 mm.)

## GLYCOL DIMETHYL ETHER

Synonyms: dimethoxyethane

Formula: CH<sub>3</sub>OCH<sub>2</sub>CH<sub>2</sub>OCH<sub>3</sub>

Formula Weight: 90.1

Melting Point: -58° C.

Boiling Point: 84 to 85° C. (at 760 mm.)

Specific Gravity: 0.863(20/4)

Solubility: ∞ (in water)

GLYCOLIC ALDEHYDE  
DIETHYLACETAL

Formula: CH<sub>2</sub>OHCH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>

Formula Weight: 134.2

Boiling Point: 167° C. (at 760 mm.)

Specific Gravity: 0.888 at 24° C.

Solubility: decomposes in hot water

## GLYCOLIC NITRILE

Formula:  $\text{HOCH}_2\text{CN}$ 

Characteristics: oily

Formula Weight: 57.1

Melting Point:  $< -72^\circ\text{C}$ .

Boiling Point:

183 $^\circ\text{C}$ . (at 760 mm.)

slight decomposition

Specific Gravity: 1.104 at 19 $^\circ\text{C}$ .

Solubility:

very soluble in water, alcohol, and  
ether

insoluble in benzene

## GLYOXAL

Synonyms:

biformyl

ethanedial

diformyl

oxalaldehyde

Formula:  $\text{CHOCHO}$ 

Characteristics: green to yellow

Formula Weight: 58.0

Melting Point: 15 $^\circ\text{C}$ .

Boiling Point:

51 $^\circ\text{C}$ . (at 776 mm.)50.4 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.26(20/4)

1.14(20/4)

10.0 lbs. per gal. at 20 $^\circ\text{C}$ .

Refractive Index: 1.3828

Uses:

organic syntheses    dye manufacture

Solubility:

 $\infty$  (of water)

soluble in alcohol

 $\infty$  (in water)

soluble in ether

Additional Data:

the commercial aqueous solution is a  
mixture of several nonvolatile,  
hydrated forms in equilibrium with  
another

## GUAIACOL ACETATE

Synonyms: eucol

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OOCCH}_3$ 

Formula Weight: 166.2

Boiling Point:

240 to 241 $^\circ\text{C}$ . (at 760 mm.)238 $^\circ\text{C}$ . (at 760 mm.) decomposes

Specific Gravity:

1.138

1.156 at 0 $^\circ\text{C}$ .

Uses:

medicine

guaiacol substitute

Solubility:

 $\infty$  (in alcohol)

soluble in olive oil

 $\infty$  (in ether)

## GUAIACOL CAPROATE

Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{O}_2\text{C}_6\text{H}_{11}$ 

Formula Weight: 222.3

Boiling Point: 168 to 170 $^\circ\text{C}$ . (at 15 mm.)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## GUAIACOL VALERATE

Synonyms: Geosote

Formula:  $\text{C}_6\text{H}_4\text{OCH}_3\text{OCOC}_4\text{H}_9$ 

Characteristics:

oily

yellow

Formula Weight: 208.3

Boiling Point:

240 to 260 $^\circ\text{C}$ . (at 760 mm.)265 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.038

1.05

Uses: medicine

Solubility:

insoluble in water

soluble in alcohol, ether, chloroform,  
and benzene

## H

## 9-HENEICOSENE

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{CH}:\text{CH}(\text{CH}_2)_{10}\text{CH}_3$ 

Formula Weight: 294.6

Melting Point:  $3^\circ\text{C}$ .Boiling Point:  $201$  to  $202^\circ\text{C}$ . (at 11 mm.)Specific Gravity: 0.802 at  $20^\circ\text{C}$ .

Solubility: insoluble in water

## HEMIMELLITENE

Synonyms:

hemellitene

1,2,3-trimethylbenzene

vic-trimethylbenzeneFormula:  $(\text{CH}_3)_3\text{C}_6\text{H}_3$ 

Formula Weight: 120.2

Melting Point:  $<-15^\circ\text{C}$ .Boiling Point:  $176.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.895(20/4)

Refractive Index: 1.51335 at  $19.55^\circ\text{C}$ .

Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## HENDECANAL

Synonyms:

undecanal                      undecylic aldehyde

n-undecylaldehydeFormula:  $\text{CH}_3(\text{CH}_2)_9\text{CHO}$ 

Formula Weight: 170.3

Melting Point:  $-4^\circ\text{C}$ .Boiling Point:  $116$  to  $117^\circ\text{C}$ . (at 18 mm.)

Specific Gravity:

0.825(23/4)                      0.830(20/4)

Refractive Index: 1.4334

Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## HENDECANE

Synonyms: undecane

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{CH}_3$ 

Formula Weight: 156.3

Melting Point:  $-26.5^\circ\text{C}$ .

Boiling Point:

 $195.84^\circ\text{C}$ . (at 760 mm.) $197^\circ\text{C}$ . (at 760 mm.) $194.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

 $0.741(20/4)^\circ\text{C}$ . $0.7449(60/60)^\circ\text{F}$ .

Refractive Index:

1.4184

1.4173

Specific Heat (Btu. per lb. per  $^\circ\text{F}$ .): $0.524$  at  $77^\circ\text{F}$ .

Heat of Vaporization (Btu. per lb.):

 $118.6$  at the boiling point $155$  at  $77^\circ\text{F}$ .

Uses: organic syntheses

Solubility:

insoluble in water	$\infty$ (in alcohol)
	$\infty$ (in ether)

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 5.3961

API gravity at  $60^\circ\text{F}$ ., 58.5liquid density (in vacuo) at  $60^\circ\text{F}$ ., 6.21aniline point,  $177.1^\circ\text{F}$ .critical temperature,  $697^\circ\text{F}$ .

critical pressure, 292 psia

coefficient of expansion,

 $0.00055$  at  $32$  to  $104^\circ\text{F}$ .total heating values (at  $77^\circ\text{F}$ .), $20,443$  Btu./lb., $125,770$  Btu./cu.ft.-gas

## HENDECANENITRILE

Synonyms:

decyl cyanide

undecylic nitrile

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{CN}$

Formula Weight: 167.3

Boiling Point: 253 to 254° C. (at 760 mm.)

### 2-HENDECANOL

Synonyms:

2-undecanol  
methylnonylcarbinol  
n-sec-undecyl alcohol

Formula:  $\text{CH}_3(\text{CH}_2)_8\text{CHOHCH}_3$

Formula Weight: 172.3

Melting Point: 12° C.

Boiling Point:

225.4° C. (at 760 mm.)  
228 to 229° C. (at 760 mm.)

Specific Gravity:

0.827(20/4)                      0.8363

Solubility (grams per 100 ml.):

0.02 (in water) at 20° C.  
soluble in alcohol      soluble in ether

### 2-HENDECANONE

Synonyms:

methyl nonyl ketone  
2-undecanone

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_8\text{CH}_3$

Formula Weight: 170.3

Melting Point:

12.1° C.                      15° C.

Boiling Point:

226 to 228° C. (at 760 mm.)  
223 to 226° C. (at 756 mm.)

Specific Gravity:

0.828(20/20)                      0.8295 at 17° C.  
0.826(20/4)

Refractive Index: 1.43002 at 17.3° C.

Uses: flavoring material

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

### 3-HENDECANONE

Synonyms:

ethyl octyl ketone      3-undecanone

Formula:  $\text{C}_2\text{H}_5\text{CO}(\text{CH}_2)_7\text{CH}_3$

Formula Weight: 170.3

Melting Point: 4.5° C.

Boiling Point:

227° C. (at 760 mm.)  
104 to 106° C. (at 760 mm.)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

### 6-HENDECANONE

Synonyms:

n-caprone                      dipentyl ketone  
diamyl ketone                  6-undecanone

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CO}(\text{CH}_2)_4\text{CH}_3$

Formula Weight: 170.3

Melting Point: 14 to 15° C.

Boiling Point: 225 to 226° C. (at 760 mm.)

Specific Gravity: 0.8262(20/4)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

### 1-HENDECENE

Synonyms:

1-undecene                       $\alpha$ -undecylene

Formula:  $\text{CH}_3(\text{CH}_2)_8\text{CH}:\text{CH}_2$

Formula Weight: 154.3

Boiling Point: 188 to 190° C. (at 760 mm.)

Specific Gravity: 0.763(20/4)

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

### 2-HENDECENE

Synonyms:

2-undecene                       $\beta$ -undecylene

## 2-HENDECENE (Cont.)

Formula:  $\text{CH}_3\text{CH}:\text{CH}(\text{CH}_2)_7\text{CH}_3$ 

Formula Weight: 154.3

Boiling Point: 192 to 193° C. (at 760 mm.)

Specific Gravity:

0.7729(20/4)      0.774(15/15)

Refractive Index: 1.4333

Solubility:

insoluble in water    ∞ (in alcohol)  
   ∞ (in ether)

## 10-HENDECEN-1-OL

Synonyms: undecylene alcohol

Formula:  $\text{CH}_2:\text{CH}(\text{CH}_2)_9\text{OH}$ 

Formula Weight: 170.3

Melting Point: -4° C.

Boiling Point: 245° C. (at 756 mm.)

Specific Gravity: 0.860(0/4)

## HENDECYL ALCOHOL

Synonyms:

decyl carbinol	undecyl alcohol
1-hendecanol	<u>n</u> -undecylic
1-undecanol	alcohol

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{CH}_2\text{OH}$ 

Characteristics:

strong and retentive fatty odor

Formula Weight: 172.3

Melting Point:

11° C.      19° C.

Boiling Point: 131° C. (at 15 mm.)

Specific Gravity: 0.8334(23/4)

Refractive Index: 1.4404

Uses: flavor fixative

Solubility:

insoluble in water    soluble in alcohol  
very soluble in ether

## HENDECYLAMINE

Synonyms:

1-aminohendecane

pri-n-undecylamineFormula:  $\text{CH}_3(\text{CH}_2)_{10}\text{NH}_2$ 

Formula Weight: 171.3

Melting Point: 16.5° C.

Boiling Point: 241.6° C. (at 760 mm.)

Solubility:

slightly soluble in water  
soluble in alcohol    soluble in ether

## 1-HENDECYNE

Synonyms:

rutyldene

1-undecyne

Formula:  $\text{CH}:\text{C}(\text{CH}_2)_8\text{CH}_3$ 

Formula Weight: 152.3

Melting Point: -33° C.

Boiling Point: 210 to 215° C. (at 760 mm.)

Specific Gravity: 0.867(25/4)

Solubility:

insoluble in water    soluble in alcohol  
   soluble in ether

## 2,4-HEPTADIENE

Formula:  $\text{CH}_3\text{CH}:\text{CHCH}:\text{CHCH}_2\text{CH}_3$ 

Formula Weight: 96.2

Boiling Point: 104 to 107° C. (at 760 mm.)

Specific Gravity: 0.733(21.5/4)

## HEPTANE

Synonyms:

dipropylmethane

heptyl hydride

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$ 

Characteristics:

volatile

highly inflammable

Formula Weight: 100.2

Melting Point: -90.5° C.

**Boiling Point:**

95 to 98°C. (at 760 mm.)  
 98.52°C. (at 760 mm.)  
 198 to 212°F. (at 760 mm.)  
 208.6 to 209.6°F. (at 760 mm.)

**Specific Gravity:**

0.694                      0.723 at 60°F.  
 0.684(20/4)              0.691(60/60)° F.  
5.76 lbs. per gal. at 60°F.

**Refractive Index:**

1.3867 at 23°C.              1.3894  
 1.38764

**Viscosity (centipoises):**

0.5236 at 0°C.              0.262 at 70°C.  
 0.4163 at 20°C.              0.2239 at 90°C.  
 0.3410 at 40°C.

**Inflammability Range (volume per cent in air):**

1.0 (lower limit)              6.0 (upper limit)

**Flash Point: 250°F. (closed)****Specific Heat (Btu. per lb. per °F.):**

0.525 at 64.8°F.

**Heat of Vaporization (Btu. per lb.):**

137.52 at the boiling point  
 156.82 at 77°F.

**Heat of Fusion (gram-calories per g.):**

33.7 at 15°C.

**Heat of Combustion (kilogram-calories per mole): 1149.9 (liquid)****Uses:**

anesthetic  
 solvent for organic syntheses

**Solubility (grams per 100 ml.):**

0.0052 (in water) at 15.5°C.  
 100 (in alcohol)  
 ∞ (in ether)                      ∞ (in chloroform)

**Additional Data:**

autoignition temperature, 452°F.  
 vapor density, 3.45  
 specific gravity of gas (ideal)  
 (air = 1.0), 3.4592  
 API gravity at 60°F.,  
 74.1                      64.0  
 liquid density (in vacuo) at 60°F.,  
 5.7367

**aniline point,**

157.5°F.                      135°F.  
 critical temperature, 266.8°C.  
 critical pressure, 26.9 atm.  
 coefficient of expansion,  
 0.00068 per °F. at 32 to 104°F.  
 total heating values (at 77°F.),  
 20,668 Btu./lb.  
 117,190 Btu./cu. ft.-gas  
 octane number 0, weight of pure vapor,  
 4470 mg./ℓ.  
 doctor test, sweet  
 kauri butanol number, 35.5  
 nitrocellulose dilution ratio, 1.30

**1, 7-HEPTANEDIOL**

Synonyms: heptamethylene glycol

Formula:  $\text{CH}_2\text{OH}(\text{CH}_2)_5\text{CH}_2\text{OH}$

Formula Weight: 132.2

Melting Point: 12°C.

**Boiling Point:**

259 to 262°C. (at 760 mm.)  
 143 to 146°C. (at 8 mm.)

**Solubility:**

soluble in water and alcohol  
 insoluble in ether

**1-HEPTANETHIOL**

Synonyms: n-heptyl mercaptan

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{SH}$

Formula Weight: 132.3

Melting Point: -43.4°C.

**Boiling Point:**

174 to 175°C. (at 760 mm.)  
 176.2°C. (at 760 mm.)  
 109°C. (at 100 mm.)  
 58°C. (at 10 mm.)

**Specific Gravity:**

0.843 at 20°C.                      0.839 at 25°C.  
 0.8389(25/4)

Refractive Index: 1.450 at 25°C.

**Solubility:**

insoluble in water              ∞ (in alcohol)  
 ∞ (in ether)

## 2-HEPTANETHIOL

Synonyms: heptyl mercaptan

Formula:  $\text{CH}_3\text{CHSHC}_5\text{H}_{11}$

Formula Weight: 132.3

Melting Point:  $-141^\circ\text{C}$ .

Boiling Point:

174 to  $175^\circ\text{C}$ . (at 765 mm.)

$164^\circ\text{C}$ . (at 760 mm.)

$98^\circ\text{C}$ . (at 100 mm.)

$47^\circ\text{C}$ . (at 10 mm.)

Specific Gravity:

0.835 at  $20^\circ\text{C}$ .      0.8312 at  $25^\circ\text{C}$ .

Refractive Index: 1.445 at  $25^\circ\text{C}$ .

Solubility: insoluble in water

## 2-HEPTANOL

Synonyms:

amylmethylcarbinol

heptyl alcohol

Formula:  $\text{CH}_3\text{CHOH}(\text{CH}_2)_4\text{CH}_3$

Formula Weight: 116.2

Boiling Point:  $160.4^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure (mm. Hg): 0.9 at  $20^\circ\text{C}$ .

Specific Gravity:

0.8187(20/4)      0.8187(20/20)

6.8 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:

1.4213      1.4190 at  $25^\circ\text{C}$ .

Flash Point:  $160^\circ\text{F}$ . (open)

Uses:

solvent for some dyes, fats, gums,

oils, resins, and waxes

synthesis of plasticizers and wetting agents

Solubility (grams per 100 ml.):

5.07 (of water) at  $20^\circ\text{C}$ .

0.35 (in water) at  $20^\circ\text{C}$ .

soluble in alcohol      soluble in ether

## 4-HEPTANOL

Synonyms:

dipropylcarbinol      heptyl alcohol

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CHOH}(\text{CH}_2)_2\text{CH}_3$

Formula Weight: 116.2

Melting Point:  $-41.5^\circ\text{C}$ .

Boiling Point:

154 to  $155^\circ\text{C}$ . (at 760 mm.)

$155.4^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.820(20/4)

Refractive Index: 1.4205

Solubility:

insoluble in water      soluble in alcohol

soluble in ether

## 2-HEPTANONE

Synonyms:

amyl methyl ketone

methyl amyl ketone

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_4\text{CH}_3$

Characteristics:

bitter-sweet taste

marked fruity odor similar to that of

isoamyl acetate

pear flavor

Formula Weight: 114.2

Boiling Point:

147 to  $154^\circ\text{C}$ . (at 760 mm.)

$150.2^\circ\text{C}$ . (at 760 mm.)

149 to  $152^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.817(20/20)      0.8166(20/20)

0.822(15/4)

6.81 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4110

Viscosity (centipoises): 0.766 at  $25^\circ\text{C}$ .

Flash Point:  $120^\circ\text{F}$ . (open)

Heat of Vaporization (gram-calories per g.): 83

## Uses:

lacquers  
solvent for nitrocellulose, rubber, and  
lacquer resins  
numerous synthetic fruit flavors

## Solubility (grams per 100 ml.):

1.5 (of water)  
0.4 (in water) at 20°C.  
soluble in alcohol    soluble in ether  
miscible with ordinary organic lacquer  
solvents

## Additional Data:

nitrocellulose dilution ratio, 3.9  
dilution ratios:  
with toluene . . . . . 3.9  
with petroleum naphtha . . . . 1.2  
with xylene . . . . . 3.6  
with mineral spirits . . . . . 1.1  
coefficient of expansion,  
0.00103 at 10 to 30°C.

## 3-HEPTANONE

## Synonyms:

butyl ethyl ketone  
ethyl n-butyl ketone

Formula:  $C_2H_5CO(CH_2)_3CH_3$

Formula Weight: 114.2

Melting Point: -39.0°C.

Boiling Point: 148.5°C. (at 760 mm.)

Specific Gravity: 0.8183(20/4)

## Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

## 1-HEPTENE

Synonyms:  $\alpha$ -heptylene

Formula:  $CH_2:CH(CH_2)_4CH_3$

Formula Weight: 98.2

Melting Point: -10°C.

## Boiling Point:

94.9°C. (at 760 mm.)  
95 to 100°C. (at 760 mm.)  
98°C. (at 760 mm.)

## Specific Gravity:

0.6993(20/4)                      0.7013(60/60)° F.  
0.703 at 19°C.

Refractive Index: 1.3994

## Specific Heat (Btu. per lb. per ° F.):

0.518 at 71.6° F.

## Heat of Vaporization (Btu. per lb.):

148.9 at the boiling point

Uses: organic synthesis

## Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

## Additional Data:

specific gravity of gas (ideal)  
(air = 1.0), 3.3896  
API gravity at 60° F., 70.3  
liquid density (in vacuo) at 60° F., 5.847  
aniline point, 81.0° F.  
coefficient of expansion,  
0.00065 at 60 to 77° F.  
total heating values (at 77° F.),  
20,380 Btu./lb.,  
117,800 Btu./cu.ft.-gas

## 2-HEPTENE

## Synonyms:

1-butyl- $\alpha$ -methylethylene  
 $\beta$ -heptylene

Formula:  $CH_3CH:CH(CH_2)_3CH_3$

Formula Weight: 98.2

## Boiling Point:

98.1 to 98.5°C. (at 760 mm.)

Specific Gravity: 0.7034(20/4)

## 3-HEPTENE

## Synonyms:

1-ethyl-2-propylethylene  
 $\gamma$ -heptylene

Formula:  $CH_3CH_2CH:CHCH_2CH_2CH_3$

Formula Weight: 98.2

## Boiling Point:

95.8 to 96.1°C. (at 760 mm.)

Specific Gravity: 0.7043(20/4)



Formula Weight: 228.4

Boiling Point:

273 to 274° C. (at 754 mm.)

137 to 140° C. (at 10 mm.)

Specific Gravity: 0.865(19/4)

Uses: almond and other flavors

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

#### HEPTYL ETHER

Synonyms:

diheptyl ether      1-heptyloxyheptane

Formula:  $(C_7H_{15})_2O$

Formula Weight: 214.4

Boiling Point:

260 to 261.9° C. (at 760 mm.)

Specific Gravity:

0.806 at 20° C.      0.815(0/4)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

#### HEPTYL FORMATE

Synonyms: formic acid heptyl ester

Formula:  $HCOOC_7H_{15}$

Characteristics:

rose-like and fruity odor  
sweet taste      plum flavor

Formula Weight: 144.2

Boiling Point: 176.7° C. (at 760 mm.)

Specific Gravity: 0.894(0/4)

Uses:

apricot, peach and plum flavors

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

#### HEPTYL METHYL ETHER

Synonyms:

1-methoxyheptane  
methyl heptyl ether

Formula:  $CH_3OC_7H_{17}$

Formula Weight: 130.2

Boiling Point: 149.8° C. (at 760 mm.)

Specific Gravity: 0.795(0/0)

Solubility:

insoluble in water      ∞ (in alcohol)  
∞ (in ether)

#### HEPTYL NITRITE

Formula:  $CH_3(CH_2)_6ONO$

Formula Weight: 145.2

Boiling Point: 155° C. (at 760 mm.)

Specific Gravity: 0.8939(0/4)

Solubility:

insoluble in water      soluble in ether

#### HEPTYL PROPIONATE

Synonyms: propionic acid heptyl ester

Formula:  $CH_3CH_2COOC_7H_{15}$

Characteristics:

rose-like odor      apricot flavor  
bitter-sweet taste

Formula Weight: 177.3

Boiling Point: 208° C. (at 760 mm.)

Specific Gravity: 0.885 at 0° C.

Uses:

apricot, peach, and pineapple flavors

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

#### HEPTYL SULFATE

Synonyms: di n-heptyl sulfate

Formula:  $[CH_3(CH_2)_6]_2SO_4$

Formula Weight: 294.4

## HEPTYL SULFATE (Cont.)

Melting Point: 11.4° C.

Boiling Point: 146.6° C. (at 1.5 mm.)

Specific Gravity: 0.9819(25/25)

Refractive Index: 1.4362 at 25° C.

## HEPTYL SULFIDE

Synonyms: diheptyl sulfide

Formula:  $[\text{CH}_3(\text{CH}_2)_6]_2\text{S}$ 

Formula Weight: 230.4

Boiling Point: 298° C. (at 760 mm.)

## 1-HEPTYNE

Synonyms:

n-amylicetylene	1-heptyne
enanthylidene	oenanthylidene

Formula:  $\text{CH}_3\text{C}(\text{CH}_2)_4\text{CH}_3$ 

Formula Weight: 96.2

Melting Point: -70° C.

Boiling Point:

99.8° C. (at 760 mm.)

26.5° C. (at 50 mm.)

110.5° C. (at 760 mm.)

Specific Gravity:

0.738(12.6/4)      0.7288(25/4)

Uses: organic syntheses

Solubility:

insoluble in water	$\infty$ (in alcohol)
	$\infty$ (in ether)

## 2-HEPTYNE

Synonyms:

butylmethylacetylene      2-heptyne

Formula:  $\text{CH}_3\text{C}:\text{C}(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 96.2

Boiling Point:

112° C. (at 760 mm.)

39.5° C. (at 50 mm.)

Specific Gravity:

0.745 at 25° C.      0.750(19/4)

Refractive Index: 1.4220 at 25° C.

Solubility:

insoluble in water	$\infty$ (in alcohol)
	$\infty$ (in ether)

## "HERCOSOL" No. 80

Synonyms:

trade name for a commercial mixture of terpene hydrocarbons and terpene ketones

Boiling Point:

172 to 225° C. (at 760 mm.)176 to 262° C. (at 760 mm.)

Specific Gravity:

0.895 to 0.905 at 20° C.

0.912 at 20° C.7.4 lbs. per gal.Flash Point: 150° F. (open)

Uses:

solvent for enamels, lacquers, and varnishes

Solubility:

water is insoluble in this compound  
very slightly soluble in water

Additional Data:

coefficient of expansion,  
0.00083 at 10 to 30° C.

dilution ratios:

with toluene . . . . . 0.4with petroleum naphtha . . . . 0.1

## HEXACHLOROBUTADIENE

Formula:  $\text{CCl}_2:\text{CClCCl}:\text{CCl}_2$ 

Formula Weight: 260.7

Melting Point: -22 to -19° C.Boiling Point: 210 to 220° C. (at 760 mm.)Specific Gravity: 1.65 to 1.70

## Uses:

solvent for rubber, synthetic rubber,  
and various polymeric substances  
high boiling nonflammable solvent  
nonflammable heat transfer liquid  
hydraulic fluid      transformer fluid

## Solubility:

insoluble in water      soluble in alcohol  
   soluble in ether  
soluble in most chlorinated solvents

## HEXACHLOROMETHYL ETHER

Formula:  $O(CCl_3)_2$

## Characteristics:

phosgene-like odor      highly irritating

Formula Weight: 252.7

## Boiling Point:

$98^\circ C.$  (at 760 mm.) decomposes

Specific Gravity: 1.538 at  $18^\circ C.$

Uses: organic syntheses

## HEXACHLOROPROPYLENE

Formula:  $CCl_3CCl:CCl_2$

Formula Weight: 248.8

Last Crystal Point:  $<-61^\circ C.$

Boiling Point:  $205$  to  $215^\circ C.$  (at 760 mm.)

Specific Gravity:  $1.74$  to  $1.78^\circ C.$

## Uses:

solvent and plasticizer for rubber and  
various other polymeric substances  
nonflammable hydraulic fluid

## Solubility:

insoluble in water      soluble in alcohol  
   soluble in ether  
soluble in most chlorinated solvents

## HEXADECANE

## Synonyms:

bioctyl      cetane

Formula:  $CH_3(CH_2)_{14}CH_3$

Formula Weight: 226.4

## Melting Point:

$18.1^\circ C.$        $18.5^\circ C.$   
 $16$  to  $20^\circ C.$

## Boiling Point:

$289.5^\circ C.$  (at 760 mm.)  
 $286.5^\circ C.$  (at 760 mm.)

## Specific Gravity:

$0.7751(20/4)$        $0.774(20/4)$

## Refractive Index:

$1.4352$        $1.43470$

Viscosity (centipoises):  $3.591$  at  $22.2^\circ C.$

Uses: organic syntheses

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
    $\infty$  (in ether)

## 1-HEXADECANETHIOL

## Synonyms:

cetyl mercaptan  
n-hexadecyl mercaptan

Formula:  $CH_3(CH_2)_{15}SH$

Formula Weight: 258.5

Melting Point:  $18^\circ C.$

Boiling Point:  $167$  to  $170^\circ C.$  (at 3 mm.)

Refractive Index:  $1.4623$

## Solubility:

insoluble in water      soluble in ether  
slightly soluble in alcohol

## tert-HEXADECANETHIOL

## Synonyms:

tert-hexadecyl mercaptan

Formula:  $C_{16}H_{33}SH$

## Characteristics:

light straw color      mercaptan odor

Formula Weight: 258.5

Solidification Point:  $-20^\circ C.$

Boiling Point:  $148$  to  $153^\circ C.$  (at 11 mm.)

Specific Gravity:  $0.869(20/20)$

Refractive Index:  $1.474$

tert-HEXADECANETHIOL (Cont.)Viscosity (centipoises): 13.88Flash Point: 265° F. (open)

## Solubility:

insoluble in water

insoluble in methyl alcohol

soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

## 1-HEXADECYNE

Formula:  $\text{CH}_3(\text{CH}_2)_{13}\text{C}:\text{CH}$ 

Formula Weight: 222.4

Melting Point: 15° C.

Boiling Point: 155° C. (at 15 mm.)

Specific Gravity: 0.797 at 20° C.

Solubility: insoluble in water

## 2-HEXADECYNE

## Synonyms:

cetylene

2-hexadecyne

Formula:  $\text{CH}_3(\text{CH}_2)_{12}\text{C}:\text{CCH}_3$ 

Formula Weight: 222.4

Melting Point: -25° C.

Boiling Point: 280 to 285° C. (at 760 mm.)

Specific Gravity: 0.804(20/4)

Solubility: insoluble in water

## 2,4-HEXADIENE

## Synonyms:

bipropenyl

dipropylene

dipropenyl

Formula:  $\text{CH}_3\text{CH}:\text{CHCH}:\text{CHCH}_3$ 

Characteristics: oily

Formula Weight: 82.1

Boiling Point: 82° C. (at 760 mm.)

Specific Gravity:

0.7108(20/4)

0.718(20/4)

Refractive Index: 1.4384

Uses: organic syntheses

Solubility: insoluble in water

## Additional Data:

aniline equivalent, 29

## 1,5-HEXADIEN-3-YNE

Synonyms: divinylacetylene

Formula:  $\text{CH}_2:\text{CHC}:\text{CCH}:\text{CH}_2$ 

Formula Weight: 78.1

Boiling Point: 83.5 to 84° C. (at 760 mm.)

Specific Gravity: 0.7851(20/4)

Refractive Index: 1.504

## 1,5-HEXADIYNE

## Synonyms:

bipropargyl

1,5-hexadiene

dipropargyl

Formula:  $\text{CH}:\text{CCH}_2\text{CH}_2\text{C}:\text{CH}$ 

Formula Weight: 78.1

Freezing Point: -6° C.

Boiling Point:

85° C. (at 760 mm.)

85.4 to 86° C. (at 760 mm.)

Specific Gravity: 0.8049(20/4)

Refractive Index: 1.44132 at 23.8° C.

Uses: organic syntheses

## Solubility:

insoluble in water    soluble in alcohol

very soluble in ether

soluble in common organic solvents

## HEXAETHYLSILICYL OXIDE

Synonyms: triethyl silicon oxide

Formula:  $[(\text{C}_2\text{H}_5)_3\text{Si}]_2\text{O}$ 

Formula Weight: 246.5

Boiling Point: 231° C. (at 760 mm.)

Specific Gravity: 0.859 at 0° C.

## Solubility:

insoluble in water

soluble in sulfuric acid

## HEXAMETHYLENE DIISOCYANATE

Formula:  $\text{OCN}(\text{CH}_2)_6\text{NCO}$ 

## Characteristics:

colorless                      pungent odor  
turns brown on standing

Formula Weight: 168.0

Boiling Point:  $143^\circ\text{C.}$  (at 20 mm.)Specific Gravity: 1.04 at  $28^\circ\text{C.}$ 

Uses: organic syntheses

## Solubility:

miscible in all proportions at room  
temperature with many organic  
solvents like acetone, ethyl acetate,  
carbon tetrachloride, nitrobenzene,  
kerosene, and toluene

## Additional Data:

the technical product is a dark brown  
liquid

toxic                      skin irritant  
polymerizes on standing

## HEXANE

## Synonyms:

caproyl hydride      hexyl hydride  
methyl n-butyl methane  
technical normal hexane may contain  
up to 4% methyl cyclopentane  
commercial n-hexane contains about  
75% n-hexane 25% methyl cyclo-  
pentane and negligible amounts of  
other hydrocarbons, the solid content  
does not exceed 0.008% by weight,  
it contains no olefins

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$ 

## Characteristics:

volatile, faint peculiar odor

Formula Weight: 86.2

## Melting Point:

$-94.3^\circ\text{C.}$                        $-95.3^\circ\text{C.}$

## Boiling Point:

$69.0^\circ\text{C.}$  (at 760 mm.)  
 $66$  to  $71^\circ\text{C.}$  (at 760 mm.)  
 $67$  to  $69^\circ\text{C.}$  (at 760 mm.)  
 $68.7^\circ\text{C.}$  (at 760 mm.)

## Specific Gravity:

$0.6603(20/4)$                        $0.66405(60/60)^\circ\text{F.}$   
 $0.659(20/4)$                        $0.668(60/60)^\circ\text{F.}$   
 $0.65937(20/4)$   
 $5.56$  lbs. per gal. at  $60^\circ\text{F.}$

## Refractive Index:

$1.37486$                        $1.37536$

## Surface Tension (dynes per cm.):

$20.5$  at  $0^\circ\text{C.}$                        $13.4$  at  $68^\circ\text{C.}$   
 $18.4$  at  $20^\circ\text{C.}$

## Viscosity (centipoises):

$0.4012$  at  $0^\circ\text{C.}$                        $0.248$  at  $50^\circ\text{C.}$   
 $0.3258$  at  $20^\circ\text{C.}$                        $0.2288$  at  $60^\circ\text{C.}$   
 $0.2708$  at  $40^\circ\text{C.}$

## Inflammability Range (volume per cent in air):

$1.25$  (lower limit)       $6.90$  (upper limit)

## Flash Point:

$-14.4^\circ\text{F.}$  (open)       $-7^\circ\text{F.}$  (closed)

Specific Heat (Btu. per lb. per  $^\circ\text{F.}$ ):

$0.536$  at  $71.6^\circ\text{F.}$

## Heat of Vaporization (Btu. per lb.):

$144.77$  at the boiling point  
 $157.40$  at  $77^\circ\text{F.}$

## Heat of Fusion (gram-calories per g.):

$36.7$  at  $15^\circ\text{C.}$

## Heat of Combustion (kilogram-calories per mole): 989.8 (liquid)

## Uses: solvent

## Solubility (grams per 100 ml.):

$0.0138$  (in water) at  $15.5^\circ\text{C.}$   
 $50$  (in alcohol) at  $33^\circ\text{C.}$   
soluble in ether  
very soluble in chloroform

## Additional Data:

weight of pure vapor,  $3800$  mg./*l.*  
vapor density,  $2.97$   
specific gravity of gas (ideal)  
(air = 1.0),  $3.4592$   
API gravity at  $60^\circ\text{F.}$ ,  
 $81.6$                        $75.5$   
aniline point,  
 $155.5^\circ\text{F.}$                        $145^\circ\text{F.}$   
critical temperature,  $234.8^\circ\text{C.}$   
critical pressure,  $29.6$  atm.  
coefficient of expansion,

## HEXANE (Cont.)

0.00075 at 32 to 86° F.  
 total heating values (at 77° F.),  
 20,771 Btu./lb.,  
 113,510 Btu./cu. ft.-gas  
 doctor test, sweet  
 kauri butanol number, 30.5  
 nitrocellulose dilution ratio, 1.25  
 autoignition temperature, 477° F.  
 aniline equivalent, -6

## HEXANE - mixed

## Synonyms:

this is a commercial mixture of  
 isomeric hexanes

## Boiling Point:

49 to 77° C. (at 760 mm.)

## Specific Gravity:

0.669(60/60)° F.

5.57 lbs. per gal. at 60° F.

## Uses:

solvent in extraction and crystallization  
 operations

## Vapor Pressure (psia):

4.7 at 70° F.

16.3 at 130° F.

9.0 at 100° F.

## 2, 5-HEXANEDIONE

## Synonyms:

acetonylacetone

1, 2 or sym-diacetylene

2, 5-diketohexane

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_2\text{COCH}_3$

Characteristics: pleasant odor

Formula Weight: 114.1

## Freezing Point:

-5.4° C.

-9° C.

## Boiling Point:

192 to 194° C. (at 760 mm.)

191.4° C. (at 760 mm.)

185 to 195° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.43 at 20° C.

## Specific Gravity:

0.970(20/4)

0.9738(20/20)

8.1 lbs. per gal. at 20° C.

## Refractive Index:

1.4256

1.449

## Surface Tension (dynes per cm):

39.6 at 28° C.

Viscosity (centipoises): 1.62 at 20° C.

Flash Point: 185° F. (open)

## Uses:

lacquers

stains

roll-coating inks

tanning agent

high boiling solvent for cellulose

acetate and cellulose nitrate

organic syntheses

## Solubility:

$\infty$  (in water)

$\infty$  (in ether)

$\infty$  (in alcohol)

insoluble in potassium hydroxide

insoluble in potassium carbonate

immiscible with hydrocarbons

## Additional Data:

xylene nitrocellulose dilution ratio, 1.8  
 produces brown discoloration with  
 human skin

## Dissolves

cellulose ester

gum rosin

kauri

cumar resin

phenolic resins

Albertol copal

castor oil

Vinylite resin AYAF

Vinylite resin VYHH

## Partly dissolves

dewaxed dammar

congo resin

orange shellac

stearic acid

linseed oil

carnauba wax

ester gum

## Does not dissolve

white mineral oil

ozokerite

neat's foot oil

aluminum stearate

paraffin wax

rubber

beeswax

## 1-HEXANETHIOL

## Synonyms:

pri-n-hexylmercaptan

hexanthiol-1

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_2\text{COCH}_3$



## 3-HEXANONE

Synonyms: ethyl n-propyl ketone

Formula:  $C_2H_5COCH_2CH_2CH_3$

Formula Weight: 100.2

Boiling Point: 123 to 124° C. (at 760 mm.)

Specific Gravity: 0.813(21.8/4)

Refractive Index: 1.39899 at 22° C.

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)

## 1-HEXENE

Synonyms:

butylethylene       $\alpha$ -hexylene

Formula:  $CH_2:CH(CH_2)_3CH_3$

Formula Weight: 84.2

Melting Point: -98.5° C.

Boiling Point:

63.4° C. (at 760 mm.)  
 64.1° C. (at 760 mm.)  
 66.0° C. (at 760 mm.)  
 68° C. (at 760 mm.)

Specific Gravity:

0.6732      0.683

Refractive Index:

1.3821      1.3876

Specific Heat (Btu. per lb. per ° F.):

0.499 at 72.3° F.

Heat of Vaporization (Btu. per lb.):

148.57 at the boiling point

Uses: organic syntheses

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 2.9053

specific gravity of liquid (in vacuo),

0.6734(20/4)° C.      0.6781(60/60)° F.

API gravity (at 60° F.), 77.2

liquid density (in vacuo at 60° F.), 5.654

aniline point, 73.0

critical temperature, 470° F.

coefficient of expansion,

0.00076 at 60 to 77° F.

total heating values (at 77° F.),

20,450 Btu./lb.,

114,100 Btu./cu. ft. of gas

## 2-HEXENE

Synonyms:

$\beta$ -hexylene

1-methyl-2-propylethylene

Formula:  $CH_3CH:CH(CH_2)_2CH_3$

Formula Weight: 84.2

Boiling Point:

67.9 to 68.1° C. (at 760 mm.)

Specific Gravity: 0.6813(20/4)

Solubility:

soluble in dilute sulfuric acid

cis-2-HEXENE

Formula:  $CH_3CH:CHCH_2CH_2CH_3$

Formula Weight: 84.2

Melting Point: -146° C.

Boiling Point: 68.2° C. (at 749 mm.)

Specific Gravity: 0.6845

Refractive Index: 1.3954

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

trans-2-HEXENE

Formula:  $CH_3CH:CHCH_2CH_2CH_3$

Formula Weight: 84.2

Melting Point: -133° C.

Boiling Point: 67.5° C. (at 750 mm.)

Specific Gravity: 0.6780

Refractive Index: 1.3935

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 3-HEXENE

## Synonyms:

sym-diethylethylene      $\gamma$ -hexylene

Formula:  $\text{CH}_3\text{CH}_2\text{CH}:\text{CHCH}_2\text{CH}_3$

Formula Weight: 84.2

## Boiling Point:

(a) 67.5° C. (at 760 mm.)

(b) 70 to 71° C. (at 760 mm.)

## Specific Gravity:

(a) 0.722(15/4)

(b) 0.693(20/20)

## 1-HEXEN-5-OL

## Synonyms: hexenyl alcohol

Formula:  $\text{CH}_2:\text{CH}(\text{CH}_2)_2\text{CHOHCH}_3$

Formula Weight: 100.2

Boiling Point: 137° C. (at 765 mm.)

Specific Gravity: 0.891 at 10° C.

## Solubility (grams per 100 ml.):

10 (in water) at 10° C.

$\infty$  (in alcohol)      $\infty$  (in ether)

## 5-HEXEN-2-ONE

## Synonyms: allylacetone

Formula:  $\text{CH}_2:\text{CHCH}_2\text{CH}_2\text{COCH}_3$

Formula Weight: 98.1

## Boiling Point:

129.5° C. (at 760 mm.)

129° C. (at 748 mm.)

## Specific Gravity:

0.847(16/4)

0.846(20/4)

Refractive Index: 1.42126 at 15.4° C.

## Solubility:

insoluble in water      $\infty$  (in alcohol)  
     $\infty$  (in ether)

## HEXITOL ANHYDRIDES

## Synonyms:

commercial mixtures of mono-anhydrohexitols (hexitans) and dianhydrohexitols (hexides)

## Formula:

$\text{C}_6\text{H}_8\text{O}(\text{OH})_4$

$\text{C}_6\text{H}_8\text{O}_2(\text{OH})_2$

## Characteristics:

sweet, sharp taste

colorless to pale straw color

hygroscopic

viscous

## Uses:

humectants

softeners

plasticizers

organic syntheses

## HEXYL ACETATE

Synonyms: acetic acid n-hexyl ester

Formula:  $\text{CH}_3\text{COO}(\text{CH}_2)_5\text{CH}_3$

## Characteristics:

fruity odor

pear flavor

bitter-sweet taste

Formula Weight: 144.2

Boiling Point: 169.2° C. (at 760 mm.)

Specific Gravity: 0.8902(0/0)

## Uses:

apple, banana, blackberry, date, gooseberry, hops, huckleberry, mulberry, pear, pineapple, and tangerine essences

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

sec-HEXYL ACETATESynonyms: acetic acid sec-hexyl ester

Formula:  $\text{CH}_3\text{COOCH}(\text{CH}_3)\text{C}_4\text{H}_9$

Formula Weight: 144.2

Boiling Point: 129 to 158° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 10 at 30° C.

## Specific Gravity:

0.861 at 20° C.

7.16 lbs. per gal. at 20° C.

Flash Point: 110° F. (open)

Solubility (grams per 100 ml.):

0.68 (of water) at 20° C.

very slightly soluble in water

sec-HEXYL ACETATE (Cont.)

## Additional Data:

coefficient of expansion,

0.00104 at 10 to 30°C.

dilution ratios:

with xylene . . . . . 1.8with mineral spirits . . . . . 0.8

## HEXYL ALCOHOL

## Synonyms:

amylcarbinol                  hexanol

1-hexanol

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH}$ 

Characteristics: faint, fruity odor

Formula Weight: 102.2

Melting Point: -51.6°C.

## Boiling Point:

157.2°C. (at 760 mm.)155 to 158°C. (at 760 mm.)153.5 to 157.5°C. (at 760 mm.)

## Specific Gravity:

0.820(20/20)                  0.8186(20/4)6.8 lbs. per gal. at 20°C.

## Refractive Index:

1.413261.41790

## Flash Point:

165°F. (open)145°F. (closed)

## Uses:

solvent for dyes and gums

organic syntheses of antiseptics,

drugs, perfumes, and esters

Solubility (grams per 100 ml.):

7.26 (of water) at 20°C.0.59 (in water) at 20°C.

very soluble in alcohol

 $\infty$  (in ether)Additional Data: vapor density, 3.52

## HEXYLAMINE

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{NH}_2$ 

Characteristics: amine odor

Formula Weight: 101.2

Melting Point: -19°C.

## Boiling Point:

132.7°C. (at 760 mm.)129 to 130°C. (at 742 mm.)126 to 132°C. (at 760 mm.)

## Specific Gravity:

0.767(20/20)0.763(25/4)Refractive Index: 1.419Flash Point: 105°F. (open)Heat of Combustion (kilogram-calories  
per mole): 1022.2 (liquid)

## Solubility:

slightly soluble in water

 $\infty$  (in ether)                   $\infty$  (in alcohol)

soluble in methyl alcohol, acetone,

benzene, gasoline, and ethyl acetate

sec-HEXYLAMINEFormula:  $\text{CH}_3\text{CHNH}_2\text{C}_4\text{H}_9$ 

Characteristics: amine odor

Formula Weight: 101.2

Boiling Point: 107 to 110°C. (at 760 mm.)Specific Gravity: 0.746 at 20°C.Flash Point: 55°F. (open)

## HEXYL ETHER

Synonyms: dihexyl ether

Formula:  $[\text{CH}_3(\text{CH}_2)_5]_2\text{O}$ 

Characteristics: mild odor

Formula Weight: 186.3

Boiling Point: 226.2°C. (at 760 mm.)Vapor Pressure (mm. Hg): 0.07 at 20°C.

## Specific Gravity:

0.7942(20/20)6.6 lbs. per gal. at 20°C.Flash Point: 170°F. (open)

## Uses:

chemical reaction medium

foam breaker component

Solubility (grams per 100 ml.):

0.12 (of water) at 20° C.

0.01 (in water) at 20° C.

#### HEXYL FORMATE

Formula:  $\text{HCOO}(\text{CH}_2)_5\text{CH}_3$

Characteristics:

strong fruity odor plum flavor  
sweet taste

Formula Weight: 130.2

Boiling Point:

153.6° C. (at 760 mm.)

153 to 154° C. (at 760 mm.)

Specific Gravity: 0.898 at 0° C.

Uses:

arrack, lemon, orange, strawberry,  
raspberry, and woodruff flavors

Solubility:

soluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

#### HEXYL NITRITE

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{ONO}$

Characteristics: yellow

Formula Weight: 131.2

Boiling Point: 129 to 130° C. (at 760 mm.)

Specific Gravity: 0.8851(20/4)

Solubility:

insoluble in water soluble in alcohol  
soluble in ether

#### HEXYL SULFATE

Synonyms: di-n-hexyl sulfate

Formula:  $[\text{CH}_3(\text{CH}_2)_5]_2\text{SO}_4$

Formula Weight: 266.4

Boiling Point: 125.3° C. (at 2 mm.)

Specific Gravity: 1.0039(25/25)

Refractive Index: 1.4344 at 25° C.

#### 1-HEXYNE

Synonyms:

butylacetylene 1-hexine

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{C}:\text{CH}$

Formula Weight: 82.1

Melting Point: -150° C.

Boiling Point: 71.5° C. (at 760 mm.)

Specific Gravity:

0.736(0/4) 0.7120(25/4)

Solubility:

insoluble in water soluble in alcohol  
soluble in ether

#### 2-HEXYNE

Synonyms:

2-hexine hexolyne  
methylpropylacetylene

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{C}:\text{CCH}_3$

Formula Weight: 82.1

Boiling Point: 84° C. (at 760 mm.)

Specific Gravity:

0.7494 at 5° C. 0.7377(13/4)

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

#### 3-HEXYNE

Synonyms:

diethylacetylene 3-hexine

Formula:  $\text{C}_2\text{H}_5\text{C}:\text{CC}_2\text{H}_5$

Formula Weight: 82.1

Specific Gravity: 0.7263 at 25° C.

Refractive Index: 1.4112 at 25° C.

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

#### HIGHER ALCOHOL PHTHALATES

Synonyms:

HTP phthalate di HTP phthalate

## HIGHER ALCOHOL PHTHALATES(Cont.)

Formula:  $C_6H_4(COOR)_2$ 

Characteristics:

non-volatile                      oily

Boiling Point: 215 to 223° C. (at 20 mm.)Specific Gravity: 1.011(15.6/4)

Uses:

plasticizer for ethyl cellulose, various  
plastics, cellulose nitrate in safety  
glass, and lacquers

## HIGHER ALCOHOLS

Synonyms:

HPT-B22, B23, B24, B25, B27, B30,  
B41

high boiling, branch chain synthetic  
alcohols of the aliphatic series

Boiling Point: 130 to 307° C. (at 760 mm.)

Uses:

antifoam compound    flotation agent  
solvent for and ingredient in fuels,  
insecticides, intermediates,  
lubricants, and metal cleaners

## HYDRACRYLIC ACID

Synonyms:

ethylene lactic acid

3-hydroxypropanoic acid

 $\beta$ -hydroxypropionic acidFormula:  $CH_2OHCH_2COOH$ 

Characteristics: syrupy

Formula Weight: 90.1

Boiling Point: decomposes

Solubility:

very soluble in water

soluble in alcohol     $\infty$  (in ether)

## HYDRACRYLONITRILE

Synonyms:

ethylene cyanohydrin

glycol cyanohydrin

3-hydroxypropanenitrile

 $\beta$ -hydroxypropionitrileFormula:  $CH_2OHCH_2CN$ Characteristics: straw colored

Formula Weight: 71.1

Melting Point: -46° C.Boiling Point: 221° C. (at 723.5 mm.)

Vapor Pressure (mm. Hg):

0.08 at 25° C.                      20.0 at 117° C.760 at 227 to 228° C.

Specific Gravity:

1.059(0/4)1.04 to1.0404(25/4)1.045(25/15)8.71 lbs. per gal.Refractive Index: 1.4241 at 25° C.Specific Heat (gram-calories per g.  
per ° C.): 0.57

Uses:

solvent for many inorganic salts  
organic syntheses

Solubility (grams per ml.):

1.64 (in ether) at 15° C:

soluble in acetone

insoluble in benzene, carbon tetra-  
chloride, and naphtha $\infty$  (in water) $\infty$  (in alcohol)

Additional Data:

it is stabilized by adjusting the pH  
with phosphoric or sulfuric acid,  
pH 7-8

copper salts tend to decompose it  
galvanized iron causes color formation  
decomposes slowly on distillation at  
760 mm.

Solubility of various cellulose esters  
in Hydracrylonitrile

Compound	Grade	Solubility
Cellulose acetate	LHI	ca. 5%
Cellulose acetate	LMI	i
Cellulose acetate butyrate	Hercose C	i
Cellulose acetate propionate	Hercose AP	10%
Ethyl cellulose	Standard epoxy (7cp)	i
Ethyl cellulose	Medium epoxy (100 cp)	i
Methyl cellulose	15 centipoise	ca. 5%
Nitrocellulose	1/2 sec. R.S. grade	10%
Nitrocellulose	60-80 sec. R.S. grade	10%

Solubility of Inorganic Salts in Hydracrylonitrile

Completely soluble	Partially soluble	Insoluble
$\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	KCl	NaCl
$\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$	$\text{CaCl}_2$	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$
$\text{SbCl}_3$	$\text{Cr}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$	$\text{CdCl}_2 \cdot 2 \frac{1}{2} \text{H}_2\text{O}$
$\text{CoCl}_2$	$\text{Cu}_2\text{Cl}_2$	$\text{NH}_4\text{Cl}$
$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
$\text{MgCl}_2$		$(\text{HCOO})_2\text{Ca}$
$\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$		$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
$\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$		$\text{CaCO}_3$
$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$		$(\text{H}_2\text{PO}_4)_2\text{Ca}$
$\text{CH}_3\text{COOK}$		$\text{K}_2\text{SO}_4$
KI		$\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$
		$\text{KH}_2\text{PO}_4$
		$\text{K}_2\text{HPO}_4$
		$\text{K}_3\text{PO}_4$

## HYDRATROPIC ACID

## Synonyms:

*d*-methyl-*d*-toluic acid  
*d*-phenylpropionic acid

Formula:  $C_6H_5CH(CH_3)COOH$

Formula Weight: 150.2

Melting Point:  $< -20^{\circ}C$ .

Boiling Point: 265 to  $267^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.1(0/4)

Solubility: slightly soluble in water

## HYDROCINNAMALDEHYDE

## Synonyms:

hydrocinnamic aldehyde  
 3-phenylpropanal  
 $\beta$ -phenylpropionaldehyde

Formula:  $C_6H_5CH_2CH_2CHO$

## Characteristics:

agreeable, fragrant, flowery odor  
 resembling *d*-tolualdehyde  
 bitter-sweet taste almond flavor

Formula Weight: 134.2

Boiling Point: 221 to  $224^{\circ}C$ . (at 744 mm.)

Specific Gravity: 1.017 to 1.019

## Uses:

perfumes  
 almond, bitter almond, cherry, green-  
 gage, and mirabelle-plum flavors

Solubility (grams per 100 ml.):

17 (in alcohol)  $\infty$  (in ether)  
 insoluble in water

one volume is soluble in:

11 volumes of 50% alcohol  
 6.5 volumes of 60% alcohol  
 1.5 volumes of 70% alcohol

## HYDROCINNAMONITRILE

## Synonyms:

hydrocinnamic nitrile  
 $\beta$ -phenylpropionitrile

Formula:  $C_6H_5CH_2CH_2CN$

Formula Weight: 131.2

Boiling Point:  $261^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.001 at  $18^{\circ}C$ .

## HYDROCINNAMYL CHLORIDE

Synonyms: hydrocinnamic chloride

Formula:  $C_6H_5CH_2CH_2COCl$

Formula Weight: 168.6

Melting Point:  $< -60^{\circ}C$ .

Boiling Point:

$225^{\circ}C$ . (at 760 mm.) decomposes

Specific Gravity: 1.135 at  $21^{\circ}C$ .

## HYDROCYANIC ACID

## Synonyms:

cyanhydric acid hydrogen cyanide  
 formonitrile prussic acid

Formula: HCN

## Characteristics:

poisonous  
 odor of bitter almonds

Formula Weight: 27.0

Melting Point:

$-12^{\circ}C$ .  $-14^{\circ}C$ .

Boiling Point:

$25.8^{\circ}C$ . (at 760 mm.)  
 $25$  to  $26^{\circ}C$ . (at 760 mm.)

Specific Gravity:

0.697 at  $18^{\circ}C$ . 0.6876(20/4)

Refractive Index: 1.2675 at  $10^{\circ}C$ .

Surface Tension (dynes per cm.):

19.1 at  $10^{\circ}C$ . 17.2 at  $25^{\circ}C$ .  
 18.4 at  $17^{\circ}C$ .

Inflammability Range (volume per cent  
 in air):

5.6 (lower limit) 40 (upper limit)

Flash Point:  $00^{\circ}F$ . (closed)

Heat of Vaporization (gram-calories  
 per g.): 210 at  $20^{\circ}C$ .

## Uses:

dye intermediate  
disinfectant  
fumigation of buildings  
organic syntheses  
laboratory reagent

## Solubility:

$\infty$  (in water)  $\infty$  (in ether)  
 $\infty$  (in alcohol)

## Additional Data:

weight of pure vapor, 1110 mg./*l.*  
vapor density, 0.7(20/4) $^{\circ}$ C.  
autoignition temperature, 1000 $^{\circ}$ F.  
critical temperature, 183.5 $^{\circ}$ C.  
critical pressure, 50.0 atm.

o-HYDROXYACETOPHENONE

Formula:  $\text{HOC}_6\text{H}_4\text{COCH}_3$

Characteristics: oily

Formula Weight: 136.1

Boiling Point: 213 $^{\circ}$ C. (at 717 mm.)

Specific Gravity: 1.131(21/4)

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in acetone)  
 $\infty$  (in ether)

## 3-HYDROXY-2-BUTANONE

## Synonyms:

acetoin  
2-butanone-3  
acetylmethylcarbinol  
dimethylketol  
methylacetylcarbinol  
methyl 1-hydroxyethyl ketone

Formula:  $\text{CH}_3\text{COCHOHCH}_3$

Characteristics: slightly yellow

Formula Weight: 88.1

Melting Point: 15 $^{\circ}$ C.

## Boiling Point:

144 to 148 $^{\circ}$ C. (at 760 mm.)  
140 to 144 $^{\circ}$ C. (at 760 mm.)

## Specific Gravity:

1.011(15/15) 1.002(15/4)

Refractive Index: 1.4194 at 15 $^{\circ}$ C.

## Uses:

aroma carrier flavors  
essences

## Solubility:

very soluble in water  
very soluble in alcohol  
very slightly soluble in ether  
insoluble in ligroin

dl- $\beta$ -HYDROXYBUTYRIC ACID

Synonyms: 3-hydroxybutanoic acid

Formula:  $\text{HOC}_3\text{H}_6\text{COOH}$

## Characteristics:

hygroscopic syrupy

Formula Weight: 104.1

Boiling Point: 130 $^{\circ}$ C. (at 12 mm.)

 $\gamma$ -HYDROXYBUTYRIC ACID

Synonyms: 4-hydroxybutanoic acid

Formula:  $\text{CH}_2\text{OHCH}_2\text{CH}_2\text{COOH}$

Formula Weight: 104.1

Melting Point: <-17 $^{\circ}$ C.

## Boiling Point:

decomposes slowly at room  
temperature

## HYDROXYBUTYRONITRILE

## Synonyms:

$\gamma$ -hydroxybutyric nitrile (dl)

Formula:  $\text{CH}_2\text{OHCH}_2\text{CH}_2\text{CN}$

Formula Weight: 85.1

Boiling Point: 238 to 240 $^{\circ}$ C. (at 760 mm.)

Specific Gravity: 1.029 at 8 $^{\circ}$ C.

## Solubility:

soluble in water, alcohol, ether, and  
chloroform  
insoluble in carbon disulfide

## HYDROXYETHYLETHYLENEDIAMINE

Formula:  $\text{CH}_2\text{OHCH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2$ 

## Characteristics:

hygroscopic  
mild ammoniacal odor

Formula Weight: 104.2

## Boiling Point:

238 to 240° C. (at 760 mm.)

243.7° C. (at 760 mm.)

232 to 250° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.02 at 20° C.

## Specific Gravity:

1.0304(20/20)8.6 lbs. per gal. at 20° C.Flash Point: 275° F. (closed)

## Uses:

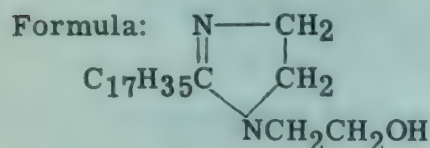
organic syntheses of dyes, drugs,  
insecticides, resins, rubber products,  
and textile compounds

## Solubility:

very soluble in water  
very soluble in alcohol  
insoluble in ether

1-HYDROXYETHYL-2-HEPTADECENYL  
GLYOXALIDINE

Synonyms: Cationic Amine 220



## Characteristics:

deep brown                      ammoniacal odor

Formula Weight: 350.0

Boiling Point: 235° C. (at 1 mm.)

## Specific Gravity:

0.9300 to 0.9360(20/20)7.77 lbs. per gal. at 20° C.Refractive Index: 1.491

## Viscosity (centipoises):

120 to 150 at 100° F.

## Uses:

agricultural sprays  
printing inks  
oil emulsifier

## Solubility:

soluble in water  
soluble in vegetable oils  
>10% (in mineral oil)  
soluble in dilute mineral acids  
soluble in common organic solvents

## Additional Data:

equivalent weight, 175  
has cationic surface active properties  
pH of a 2% solution, 10.8

## 4-HYDROXY-3-HEXANONE

## Synonyms:

diethylketol                      propiopin

Formula:  $\text{C}_2\text{H}_5\text{COCHOHC}_2\text{H}_5$ 

Formula Weight: 116.2

Boiling Point: 57 to 78° C. (at 10 mm.)

Specific Gravity: 0.956(21/4)

Refractive Index: 1.4340 at 21° C.

## HYDROXYETHYLMORPHOLINE

Formula:  $\text{CH}_2\text{OHCH}_2\text{NCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2$ 

Formula Weight: 131.2

Boiling Point: 225.5° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.11 at 20° C.

## Specific Gravity:

1.0724(20/20)8.9 lbs. per gal. at 20° C.Flash Point: 210° F. (open)

## Solubility:

∞ (of water)                      ∞ (in water)

## α-HYDROXYISOBUTYRONITRILE

## Synonyms:

acetone cyanohydrin  
acetone cyanhydrin  
2-hydroxy-2-methylpropanenitrile  
isopropyl cyanohydrin  
oxyisobutyric nitrile

Formula:  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CN}$

Formula Weight: 85.1

Melting Point:

-19° C.

-20° C.

Boiling Point:

120° C. (at 760 mm.) decomposes

82° C. (at 23 mm.)

Specific Gravity: 0.932 at 19° C.

Refractive Index: 1.3996

Uses: insecticide

Solubility:

very soluble in water

very soluble in alcohol

very soluble in ether

very slightly soluble in petroleum ether

### $\beta$ -HYDROXYISOVALERIC ACID

Synonyms:

3-hydroxy-3-methylbutanoic acid

Formula:  $(\text{CH}_3)_2\text{COHCH}_2\text{COOH}$

Characteristics: syrupy

Formula Weight: 118.1

Melting Point: < -32° C.

Solubility:

very soluble in water, alcohol, and ether

### $\beta$ -HYDROXY- $\alpha$ -METHYL VALERALDEHYDE

Synonyms: propionaldol

Formula:  $\text{C}_2\text{H}_5\text{CHOHCH}(\text{CH}_3)\text{CHO}$

Formula Weight: 116.2

Boiling Point: 84 to 86° C. (at 11 mm.)

Specific Gravity: 0.986(25/4)

Solubility: soluble in water

### 5-HYDROXY-4-OCTANONE

Synonyms: butyrolin

Formula:  $\text{C}_3\text{H}_7\text{CHOHCOC}_3\text{H}_7$

Formula Weight: 144.2

Boiling Point: 180 to 190° C. (at 760 mm.)

Specific Gravity: 0.911(16.7/4)

### 1-HYDROXY-2-PROPANONE

Synonyms:

acetol

acetylcarbinol

acetonyl alcohol

hydroxyacetone

Formula:  $\text{CH}_3\text{COCH}_2\text{OH}$

Formula Weight: 74.1

Melting Point: -17° C.

Boiling Point:

145° C. (at 760 mm.)

146° C. (at 760 mm.) decomposes

Specific Gravity: 1.0824(20/20)

Refractive Index: 1.4295

Uses: solvent for nitrocellulose

Solubility:

$\infty$  (in water)

$\infty$  (in ether)

$\infty$  (in alcohol)

### o-HYDROXYPROPIOPHENONE

Synonyms: o-propionyl phenol

Formula:  $\text{C}_2\text{H}_5\text{COC}_6\text{H}_4\text{OH}$

Formula Weight: 150.2

Boiling Point: 115° C. (at 15 mm.)

Solubility:

very slightly soluble in water

soluble in alcohol, ether, and alkali

### m-HYDROXYSTYRENE

Synonyms: m-vinyl phenol

Formula:  $\text{CH}_2\text{:CHC}_6\text{H}_4\text{OH}$

Characteristics: oily

Formula Weight: 120.1

Boiling Point: 114 to 116° C. (at 17 mm.)

HYDROXY- $\gamma$ -VALEROLACTONESynonyms:  $\gamma$ -hydroxyvaleric lactoneFormula:  $\text{CH}_3\text{CHCH}_2\text{CH}_2\text{COO}$ 

Formula Weight: 100.1

Melting Point:  $< -18^\circ\text{C}$ .Boiling Point:  $207$  to  $208^\circ\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity: 1.050(22/4)

Solubility:

 $\infty$  (in water)

insoluble in aqueous potassium carbonate

## I

## INDAN

Synonyms:

2,3-dihydroindene hydrindene

Formula:  $\text{C}_6\text{H}_4\text{CH}_2\text{CH}_2\text{CH}_2$ 

Formula Weight: 118.2

Boiling Point:

 $177^\circ\text{C}$ . (at  $760\text{ mm.}$ ) $176.5^\circ\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity:

0.963(26/4)

0.965(20/4)

Refractive Index: 1.53877 at  $16.4^\circ\text{C}$ .

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## INDENE

Formula:  $\text{C}_6\text{H}_4\text{CH}_2\text{CH}:\text{CH}$ 

Formula Weight: 116.2

Melting Point:  $-2^\circ\text{C}$ .

Boiling Point:

 $181$  to  $182^\circ\text{C}$ . (at  $760\text{ mm.}$ ) $182.4^\circ\text{C}$ . (at  $760\text{ mm.}$ )

Specific Gravity:

0.991(25/25)

1.006(20/4)

Refractive Index: 1.57107 at  $12.7^\circ\text{C}$ .

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

soluble in turpentine, pyridine, carbon tetrachloride, acetone, and carbon disulfide

## IODOACETONITRILE

Synonyms: iodomethylcyanide

Formula:  $\text{CH}_2\text{ICN}$ 

Characteristics: oily

Formula Weight: 167.0

Boiling Point:

 $182$  to  $184^\circ\text{C}$ . (at  $720\text{ mm.}$ ) decompose

Specific Gravity: 2.307

Solubility:

soluble with decomposition in water

o-IODOANISOLEFormula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{I}$ 

Characteristics: yellow

Formula Weight: 234.1

Boiling Point:  $240$  to  $241^\circ\text{C}$ . (at  $760\text{ mm.}$ )Specific Gravity: 1.8 at  $20^\circ\text{C}$ .

Solubility:

insoluble in water soluble in benzene  
 $\infty$  (in alcohol)  $\infty$  (in chloroform)  
 $\infty$  (in ether)

## IODOBENZENE

Synonyms: phenyl iodide

Formula:  $C_6H_5I$

Formula Weight: 204.0

Melting Point:

-28.5° C.                      -31.4° C.

Boiling Point: 188.6° C. (at 760 mm.)

Specific Gravity:

1.824(25/4)                      1.832(20/4)

Refractive Index: 1.62145 at 18.5° C.

Solubility (grams per 100 ml.):

0.034 (in water) at 30° C.

soluble in alcohol

soluble in chloroform

∞ (in ether)

Additional Data:

critical temperature, 448° C.

critical pressure, 44.7 atm.

o-IODOBIPHENYL

Synonyms: o-iododiphenyl

Formula:  $IC_6H_4C_6H_5$

Formula Weight: 280.1

Boiling Point: 189 to 192° C. (at 36 mm.)

Specific Gravity: 1.604(25/25)

## 1-IODOBUTANE

Synonyms: n-butyl iodide

Formula:  $CH_3CH_2CH_2CH_2I$

Formula Weight: 184.0

Melting Point: -103.5° C.

Boiling Point:

129.9° C. (at 760 mm.)

131° C. (at 760 mm.)

Specific Gravity: 1.617(20/4)

Refractive Index: 1.50006

Solubility (grams per 100 ml.):

0.0202 (in water) at 17.5° C.

∞ (in alcohol)                      ∞ (in ether)

## 2-IODOBUTANE

Synonyms:

sec-butyl iodide

ethyl methyl iodomethane

Formula:  $C_2H_5CHICH_3$

Formula Weight: 184.0

Melting Point: -104.0° C.

Boiling Point:

117.5° C. (at 760 mm.)

119 to 122° C. (at 760 mm.)

118 to 119° C. (at 760 mm.)

Specific Gravity: 1.595(20/4)

Solubility:

insoluble in water    ∞ (in ether)

very soluble in alcohol

## 1-iodo-2-bUTENE

Synonyms: crotonyl iodide

Formula:  $CH_3CH:CHCH_2I$

Formula Weight: 182.0

Boiling Point:

132 to 133° C. (at 760 mm.) decomposes

Specific Gravity: 1.682 at 0° C.

## IODOCYCLOHEXANE

Synonyms: cyclohexyl iodide

Formula:  $C_6H_{11}I$

Formula Weight: 210.1

Boiling Point: 192° C. (at 742 mm.)

Specific Gravity: 1.626(15/15)

## 1-iododecANE

Synonyms: prim-n-decyl iodide

Formula:  $CH_3(CH_2)_9I$

Formula Weight: 268.2

Boiling Point: 132° C. (at 15 mm.)

Specific Gravity:

1.260(16/4)

1.2567(20/4)

Refractive Index: 1.48269

IODOETHANE

Synonyms:

ethyl iodide                      monoiodoethane  
hydriodic ether

Formula:  $C_2H_5I$

Formula Weight: 156.0

Melting Point:

-111 to  $-105^{\circ}C$ .                       $-108.5^{\circ}C$ .

Boiling Point:  $72.2^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.933(20/4)                      1.9245(25/4)

Refractive Index: 1.5222 at  $7.0^{\circ}C$ .

Uses:

anesthetic                      organic syntheses

Solubility (grams per 100 ml.):

0.4 (in water) at  $20^{\circ}C$ .

soluble in alcohol, ether, chloroform,  
and benzene

Additional Data:

turns brown on exposure to light  
noninflammable

2-iodo-1-ethanol

Synonyms:

ethylene iodohydrin  
glycol iodohydrin

Formula:  $CH_2ICH_2OH$

Formula Weight: 172.0

Boiling Point:  $85^{\circ}C$ . (at 25 mm.)

Specific Gravity: 2.197(20/4)

Solubility:

soluble in water                      soluble in alcohol

$\beta$ -iodoethyl acetate

Formula:  $CH_3COOCH_2CH_2I$

Formula Weight: 214.0

Boiling Point:  $184^{\circ}C$ . (at 743 mm.)

Specific Gravity: 2.441 at  $20^{\circ}C$ .

iodoethylene

Synonyms:

iodoethene                      vinyl iodide

Formula:  $CH_2:CHI$

Formula Weight: 154.0

Boiling Point:  $56^{\circ}C$ . (at 760 mm.)

Specific Gravity: 2.08 at  $0^{\circ}C$ .

Solubility:

insoluble in water                       $\infty$  (in alcohol)  
 $\infty$  (in ether)

soluble in chloroform, benzene,  
carbon disulfide, and toluene

1-iodohexane

Synonyms: n-hexyl iodide

Formula:  $CH_3(CH_2)_4CH_2I$

Formula Weight: 212.1

Boiling Point:  $180^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.439 to 1.441(20/4)

Refractive Index: 1.4929

iodomethane

Synonyms: methyl iodide

Formula:  $CH_3I$

Characteristics: colorless to brown

Formula Weight: 142.0

Melting Point:

$-64.4^{\circ}C$ .                       $-66.1^{\circ}C$ .

Boiling Point:

42.4 to  $42.5^{\circ}C$ . (at 760 mm.)  
 $45.35^{\circ}C$ . (at 760 mm.)

Specific Gravity:

2.2852                      2.279(20/4)

Refractive Index: 1.5293 at  $22^{\circ}C$ .

Uses: medicine

Solubility (grams per 100 ml.):

1.8 (in water) at  $15^{\circ}C$ .

1.4 (in water) at  $20^{\circ}C$ .

$\infty$  (in alcohol)                       $\infty$  (in ether)

## Additional Data:

turns brown when exposed to light  
critical temperature, 255° C.  
critical pressure, 54.6 atm.

## 1-iodo-2-methylbutane

Synonyms: pri-act-amyl iodide

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{I}$

Formula Weight: 198.1

Boiling Point: 148° C. (at 760 mm.)

Specific Gravity: 1.524(20/4)

Refractive Index: 1.4981 at 15° C.

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## 2-iodo-2-methylbutane

Synonyms: tert-amyl iodide

Formula:  $\text{CH}_3\text{CH}_2\text{C}(\text{I})(\text{CH}_3)\text{CH}_3$

Formula Weight: 198.1

Boiling Point:

127° C. (at 765 mm.)  
125 to 128° C. (at 760 mm.)

Specific Gravity:

1.471(19/19)      1.497 at 19° C.

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

## 1-iodo-3-methylbutane

Synonyms: isoamyl iodide

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{I}$

Formula: 198.1

Boiling Point: 148° C. (at 760 mm.)

Specific Gravity: 1.515(18/4)

Solubility:

insoluble in water    ∞ (in ether)  
very soluble in alcohol

## 1-iodo-2-methylhexane

Synonyms: heptyl iodide

Formula:  $\text{CH}_2\text{ICH}(\text{CH}_3)(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 226.1

Boiling Point: 78 to 79° C. (at 19 mm.)

Specific Gravity: 1.366(21/4)

Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

## 1-iodo-2-methylpropane

Synonyms: isobutyl iodide

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{I}$

Formula Weight: 184.0

Melting Point:

-90.7° C.      -93.5° C.

Boiling Point:

120 to 120.4° C. (at 760 mm.)

Specific Gravity:

1.606(20/4)      1.605

Refractive Index: 1.49597

Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

## 2-iodo-2-methylpropane

Synonyms:

tert-butyl iodide  
trimethyliodomethane

Formula:  $(\text{CH}_3)_3\text{CI}$

Formula Weight: 184.0

Melting Point: -33.65° C.

Boiling Point:

99 to 100° C. (at 760 mm.) decomposes

Specific Gravity:

1.370(18.5/15)      1.571(0/4)

Solubility:

insoluble and decomposes in water  
∞ (in alcohol)      ∞ (in ether)

## 1-IODONAPHTHALENE

## Synonyms:

 $\alpha$ -iodonaphthalene $\alpha$ -naphthyl iodideFormula:  $C_{10}H_7I$ 

Characteristics: oily

Formula Weight: 254.1

Boiling Point: 305°C. (at 760 mm.)

Specific Gravity: 1.7344(15/4)

Refractive Index: 1.70540 at 14°C.

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 1-IODONONANE

Synonyms: n-nonyl iodideFormula:  $CH_3(CH_2)_7CH_2I$ 

Formula Weight: 254.2

Boiling Point: 117°C. (at 15 mm.)

Specific Gravity: 1.287(16/4)

## 1-ODOOCTANE

Synonyms: pri-n-octyl iodideFormula:  $CH_3(CH_2)_6CH_2I$ 

Formula Weight: 240.1

Melting Point: -45.9°C.

Boiling Point: 255.5°C. (at 760 mm.)

## Specific Gravity:

1.341 at 15°C. 1.337(16/4)

1.3531 at 15°C.

Refractive Index: 1.489

## Solubility:

insoluble in water soluble in alcohol  
soluble in ether

## 1-IODOPENTANE

## Synonyms:

n-amyl iodide amyl iodideFormula:  $CH_3(CH_2)_3CH_2I$ 

Formula Weight: 198.1

Melting Point: -85.6°C.

## Boiling Point:

156°C. (at 760 mm.)

155.4°C. (at 739 mm.)

Specific Gravity: 1.510 to 1.517(20/4)

Refractive Index: 1.4955

## Solubility:

insoluble in water  $\infty$  (in ether)

soluble in alcohol

## 2-IODOPENTANE

Synonyms: sec-n-amyl iodideFormula:  $C_3H_7CHICH_3$ 

Formula Weight: 198.1

Boiling Point: 144 to 145°C. (at 760 mm.)

Specific Gravity: 1.507(17/4)

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)o-IODOPHENETOLEFormula:  $IC_6H_4OC_2H_5$ 

Formula Weight: 248.1

Boiling Point: 245°C. (at 736 mm.)

## Solubility:

insoluble in water soluble in alcohol  
soluble in ether

## 1-IODOPROPANE

## Synonyms:

n-propyl iodide propyl iodideFormula:  $CH_3CH_2CH_2I$ 

Formula Weight: 170.0

## Melting Point:

-98.8°C.

-101.4°C.

Boiling Point: 102.4°C. (at 760 mm.)

## Specific Gravity:

1.743(20/4)

1.747

Refractive Index: 1.50508

Solubility (grams per 100 ml.):

0.0867 (in water) at 20°C.

0.11 (in water) at 20°C.

∞ (in alcohol) ∞ (in ether)

### 2-iodopropane

Synonyms: isopropyl iodide

Formula:  $(\text{CH}_3)_2\text{CHI}$

Formula Weight: 170.0

Melting Point: -90.8°C.

Boiling Point: 89.5°C. (at 760 mm.)

Specific Gravity:

1.705(25/25) 1.703(20/4)

Refractive Index: 1.49969

Solubility (grams per 100 ml.):

0.14 (in water) at 20°C.

∞ (in alcohol)

∞ (in chloroform)

∞ (in ether)

∞ (in benzene)

### 3-iodo-1-propanol

Synonyms:

α-iodohydrin

trimethylene iodohydrin

Formula:  $\text{CH}_2\text{ICH}_2\text{CH}_2\text{OH}$

Formula Weight: 186.0

Boiling Point: 225°C. (at 748 mm.)

Specific Gravity: 1.998(20/4)

Solubility:

very slightly soluble in water

soluble in alcohol soluble in ether

### 3-iodopropene

Synonyms: allyl iodide

Formula:  $\text{CH}_2\text{:CHCH}_2\text{I}$

Characteristics: yellow

Formula Weight: 168.0

Melting Point: -99.3°C.

Boiling Point:

102°C. (at 734 mm.)

103.1°C. (at 760 mm.)

Specific Gravity: 1.848(12/12)

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

soluble in chloroform

### 3-iodopropyne

Synonyms: propargyl iodide

Formula:  $\text{CH:CCH}_2\text{I}$

Formula Weight: 166.0

Boiling Point: 115°C. (at 760 mm.)

Specific Gravity: 2.018 at 0°C.

Solubility: soluble in ether

### m-iodotoluene

Synonyms: m-tolyl iodide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{I}$

Formula Weight: 218.1

Boiling Point: 204°C. (at 760 mm.)

Specific Gravity: 1.698 at 20°C.

Solubility:

insoluble in water ∞ (in alcohol)

∞ (in ether)

### o-iodotoluene

Synonyms: o-tolyl iodide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{I}$

Formula Weight: 218.1

Boiling Point: 211 to 212°C. (at 760 mm.)

Specific Gravity:

1.698 at 20°C. 1.697

Refractive Index: 1.61066 at 15.9°C.

Solubility:

insoluble in water ∞ (in alcohol)

∞ (in ether)

iodo-m-XYLENE

Synonyms:

2-iodo-1,3-dimethylbenzene

Formula:  $\text{C}_6\text{H}_3(\text{CH}_3)_2$

Formula Weight: 232.1

Boiling Point: 228 to 230° C. (at 760 mm.)

$\alpha$ -IONONE

Synonyms:

4-(2,6,6-trimethyl-2-cyclohexenyl)-  
3-buten-2-one  
cyclocitrylidene acetone

Formula:  $\text{C}_{10}\text{H}_{16}:\text{CHCOCH}_3$

Characteristics:

colorless to green-yellow  
odor of cedar wood  
oily  
faint sweet taste  
raspberry flavor

Formula Weight: 192.3

Boiling Point:

147.5° C. (at 28 mm.)  
136° C. (at 17 mm.)

Specific Gravity: 0.930 at 20° C.

Refractive Index: 1.49842 at 22.3° C.

Uses:

perfumery  
currant, orris, peach, raspberry,  
strawberry, and violet flavors

Solubility:

1 cc. in 200 cc. (in water)  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
soluble in chloroform  
one volume dissolves in:  
60 volumes of 45% alcohol and  
1 volume of 90% alcohol

$\beta$ -IONONE

Synonyms:

4-(2,6,6-trimethyl-1-cyclohexenyl)-  
3-buten-2-one

Formula:  $\text{C}_{10}\text{H}_{16}:\text{CHCOCH}_3$

Formula Weight: 192.3

Boiling Point: 140° C. (at 18 mm.)

Specific Gravity:

0.935 0.944 at 20° C.

Refractive Index: 1.51977 at 18.9° C.

Solubility:

water is insoluble in this substance  
slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

IONONE

Synonyms:

the commercial product is usually a  
mixture of  $\alpha$ - and  $\beta$ -ionone  
Irisone

Boiling Point: 126 to 128° C. (at 12 mm.)

Specific Gravity: 0.933 to 0.937(25/25)

Refractive Index: 1.503 to 1.508

Uses:

perfumes flavors

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  
soluble in 2 to 3 volumes of  
70% alcohol

$\beta$ -IRONE

Synonyms:

natural irone  
4-(2,2,6-trimethyl-3-cyclohexenyl)-  
3-buten-2-one

Characteristics: oily

Formula Weight: 192.3

Boiling Point: 144° C. (at 16 mm.)

Specific Gravity: 0.939 at 20° C.

Refractive Index: 1.5011

Uses:

perfumes flavoring

Solubility:

very slightly soluble in water  
very soluble in alcohol  
very soluble in ether

ISOAMYL ACETATE

Synonyms:

- acetic acid isoamyl ester
- amyl acetate                      banana oil
- 3-methyl-1-butanol acetate
- γ-methylbutyl ethanoate
- pear oil

Formula:  $\text{CH}_3\text{COO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$

Characteristics:

- pear and banana-like odor in low concentrations and increasingly disagreeable odor in higher concentrations
- bitter-sweet taste      pear-like flavor

Formula Weight: 130.2

Melting Point: -78.5° C.

Boiling Point:

- 138 to 142° C. (at 760 mm.)
- 142.5° C. (at 760 mm.)
- 110 to 150° C. (at 760 mm.)
- 138 to 140° C. (at 760 mm.)

Specific Gravity:

- 0.876(15/4)                      0.857 to
- 0.8699(25/4)                      0.865(20/20)
- 7.17 lbs. per gal. at 20° C.

Refractive Index:

- 1.40170 at 17.9° C.      1.400 at 21° C.

Surface Tension (dynes per cm.):

- 26.6 (in air) at 0° C.
- 24.7 at 20° C.
- 17.1 at 100° C.

Viscosity (centipoises):

- 10% 1/2 sec. R.S. nitrocellulose solution, 61

Flash Point:

- 100° F. (open)
- 92° C., 84° C. (closed)

Uses:

- solvent for nitrocellulose and tannin, film, cement, collodion preparations, artificial leather, and camphor
- a common and widely used synthetic flavoring component

Solubility (grams per 100 ml.):

- 1.8 (of water) at 25° C.
- 0.16 (in water) at 25° C.
- 0.25 (in water) at 15° C.
- ∞ (in alcohol)                      ∞ (in ether)
- soluble in amyl alcohol
- soluble in ethyl acetate
- 1 volume dissolves in 21 volumes of 45%, in 8 volumes of 50%, in 1.5 volumes of 60%, and in 1 volume of 70% alcohol

Additional Data:

- the technical grade may contain varying amounts of butyl, propyl, hexyl, and other acetates
- coefficient of expansion, 0.00066 per ° F.      0.00199 per ° C.
- autoignition temperature, 715° F.
- vapor density, 4.49
- dilution ratios (nitrocellulose solution method),
  - with toluene . . . . . 2.5
  - with petroleum naphtha . . . . 1.4

Blush Resistance at 90° F.  
(10% 1/2 sec. RS nitrocellulose solution)

	Clear	Blush
Relative humidity	<u>85%</u>	<u>90%</u>

Evaporation Rate at 95° F.

%	Minutes
5	<u>1 1/2</u>
25	<u>8 1/4</u>
50	<u>18 1/2</u>
75	<u>30</u>
90	<u>45</u>
95	<u>51 3/4</u>

For additional data see under Amyl Acetate

ISOAMYL ALCOHOL

Synonyms:

- sec-butyl carbinol
- amyl alcohol
- 1-hydroxy-3-methylbutane
- isobutyl carbinol
- 3-methyl-1-butanol
- 2-methyl-4-butanol
- prim-isoamyl alcohol

## ISOAMYL ALCOHOL (Cont.)

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$ 

## Characteristics:

unpleasant, irritating, nonresidual  
odor which on dilution becomes  
agreeably fruity  
bitter, burning taste  
apricot flavor

Formula Weight: 88.2

Melting Point:  $-117.2^\circ\text{C}$ .

## Boiling Point:

130.5 $^\circ\text{C}$ . (at 760 mm.)  
130 to 132 $^\circ\text{C}$ . (at 760 mm.)  
128 to 132 $^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.812(20/4)                      0.81 to  
0.813(15/4)                      0.82(20/20)  
6.79 lbs. per gal.

## Refractive Index:

1.4084 at 17.8 $^\circ\text{C}$ .    1.41

## Surface Tension (dynes per cm.):

25.3 (in air) at 0 $^\circ\text{C}$ .  
23.8 at 20 $^\circ\text{C}$ .  
17.7 at 100 $^\circ\text{C}$ .

## Viscosity (centipoises):

3.86 at 24 $^\circ\text{C}$ .            1.48 at 59 $^\circ\text{C}$ .

## Inflammability Range (volume per cent in air): 1.2 (lower limit)

## Flash Point:

132 $^\circ\text{F}$ ., 115 $^\circ\text{F}$ . (open)  
103 to 109 $^\circ\text{F}$ . (closed)

Specific Heat (gram-calories per g. per  $^\circ\text{C}$ .): 0.686 at 75 $^\circ\text{C}$ . (liquid)Heat of Vaporization (gram-calories per g.): 105.4

## Uses:

organic synthesis of esters  
pharmaceutical products  
photographic chemical  
solvent  
synthetic apricot, banana, cherry,  
greengage, malt, orange, plum and  
whisky flavors

## Solubility (grams per 100 ml.):

2.672 (in water) at 22 $^\circ\text{C}$ .  
2 (in water) at 14 $^\circ\text{C}$ .  
 $\infty$  (in alcohol)             $\infty$  (in ether)  
soluble in methyl alcohol, acetone,  
benzene, gasoline, and ethyl acetate

## Additional Data:

coefficient of expansion,  
0.00089 per  $^\circ\text{C}$ .    0.00051 per  $^\circ\text{F}$ .  
autoignition temperature, 667 $^\circ\text{F}$ .  
vapor density, 3.04

## ISOAMYLAMINE

Synonyms: 1-amino-3-methylbutane

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{NH}_2$ 

Formula Weight: 87.2

Boiling Point: 95 $^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.7505(20/4)            0.751(18/4)

## Solubility:

soluble in water  
soluble in chloroform  
 $\infty$  (in alcohol)             $\infty$  (in ether)

N-ISOAMYLANILINESynonyms: N-isoamylphenylamineFormula:  $\text{C}_5\text{H}_{11}\text{NHC}_6\text{H}_5$ 

Formula Weight: 163.3

Boiling Point: 254.5 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.928(15/4)

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ISOAMYLBENZENE

Synonyms: 3-methyl-1-phenylbutane

Formula:  $\text{C}_6\text{H}_5(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 148.2

## Boiling Point:

194 $^\circ\text{C}$ . (at 760 mm.)  
198 to 199 $^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.859(20/4)      0.885(20/4)

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

## ISOAMYL BENZOATE

## Synonyms:

benzoic acid isoamyl ester  
3-methyl-1-butanol benzoateFormula:  $C_6H_5COO(CH_2)_2CH(CH_3)_2$ 

## Characteristics:

penetrating disagreeable odor  
bitter-sweet taste    almond flavor

Formula Weight: 192.3

## Boiling Point:

260.7° C. (at 746 mm.)  
262° C. (at 760 mm.)

## Specific Gravity:

0.992(14/14)      0.9925 at 19° C.

## Uses:

synthetic almond, cocoa, cranberry,  
gooseberry, mulberry, nut, peach,  
plum, quince, and tangerine flavors

## Solubility:

insoluble in water     $\infty$  (in ether)  
very soluble in alcohol  
one volume dissolves in:  
15 volumes of 70% alcohol and in  
3 volumes of 80% alcohol

## ISOAMYL BORATE

Synonyms: triisoamyl borate

Formula:  $B(OC_5H_{11})_3$ 

Characteristics: alcoholic odor

Formula Weight: 272.2

Melting Point: -50° C.

## Boiling Point:

255° C. (at 760 mm.)  
240 to 265° C. (at 760 mm.)

## Specific Gravity:

0.872(0/4)      0.855(20/20)

Refractive Index: 1.421

## Solubility:

decomposes in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)

## ISOAMYL BUTYRATE

## Synonyms:

butyric acid isoamyl ester  
 $\gamma$ -methylbutyl butanoateFormula:  $CH_3(CH_2)_2COOC_5H_{11}$ 

## Characteristics:

agreeably pear-like odor which on  
dilution resembles pineapple and  
banana  
sweet taste      pineapple aroma

Formula Weight: 158.2

Melting Point: -73.2° C.

## Boiling Point:

159 to 179° C. (at 760 mm.)  
178.6° C. (at 760 mm.)  
150 to 180° C. (at 760 mm.)

## Specific Gravity:

0.882(0/4)      0.860(15/4)  
0.866(19/15)

Refractive Index: 1.413

## Uses:

solvent and plasticizer for cellulose  
acetate  
large variety of flavoring extracts and  
essences

Solubility (grams per 100 ml.):

0.054 (in water) at 50° C.  
very soluble in alcohol  
very soluble in ether

## ISOAMYL CAPROATE

## Synonyms:

caproic acid isoamyl ester  
 $\gamma$ -methylbutyl hexanoateFormula:  $CH_3(CH_2)_4COOC_5H_{11}$ 

## Characteristics:

characteristics fruity odor  
bitter taste      pineapple flavor

## ISOAMYL CAPROATE (Cont.)

Formula Weight: 186.3

Boiling Point:

94 to 96° C. (at 10 mm.)

224 to 227° C. (at 760 mm.)

Specific Gravity: 0.861

Uses:

synthetic apple, apricot, banana,  
gooseberry, greengage, mirabelle-  
plum, peach, quince, rum, and  
strawberry flavors

Solubility:

insoluble in water    soluble in alcohol

## ISOAMYL CAPRYLATE

Synonyms:

caprylic acid isoamyl ester  
γ-methylbutyl octanoate

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{COOC}_5\text{H}_{11}$ 

Characteristics:

agreeably fruity odor which on dilution  
resembles cognac  
sweet taste                      brandy flavor

Formula Weight: 214.3

Boiling Point: 136° C. (at 10 mm.)

Uses:

synthetic arrack, brandy, and rum  
flavors for alcoholic beverages

Solubility:

insoluble in water    soluble in alcohol

## ISOAMYL CARBONATE

Synonyms: diisoamyl carbonate

Formula:  $(\text{C}_5\text{H}_{11}\text{O})_2\text{CO}$ 

Formula Weight: 202.3

Boiling Point: 228.7° C. (at 760 mm.)

Specific Gravity: 0.912(15/4)

## ISOAMYL CHLOROFORMATE

Synonyms:

γ-methylbutyl chloromethanoate  
isoamyl chlorocarbonate

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{OCOCI}$ 

Formula Weight: 150.6

Boiling Point: 155 to 156° C. (at 760 mm.)

Specific Gravity:

1.028(18.5/15)

1.024(25/25)

Solubility:

insoluble in water    ∞ (in alcohol)  
∞ (in ether)

## ISOAMYL DISULFIDE

Synonyms: diisoamyl disulfide

Formula:  $(\text{C}_5\text{H}_{11})_2\text{S}_2$ 

Formula Weight: 206.4

Boiling Point:

250° C. (at 760 mm.)

slight decomposition

122 to 125° C. (at 10 mm.)

Specific Gravity: 0.918 at 19° C.

Solubility: decomposes in water

## ISOAMYL ETHER

Synonyms:

diisoamyl ether  
3-methyl-1-(γ-methylbutoxy) butane

Formula:  $[(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2]_2\text{O}$ 

Formula Weight: 158.3

Boiling Point:

172.5 to 173.0° C. (at 760 mm.)

171 to 172° C. (at 748 mm.)

Specific Gravity: 0.78073(15/15)

Refractive Index: 1.408

Solubility:

insoluble in water    ∞ (in ether)  
∞ (in alcohol)            ∞ (in chloroform)

## ISOAMYL FORMATE

## Synonyms:

formic acid isoamyl ester  
 $\gamma$ -methylbutyl methanoate

Formula:  $\text{HCOO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$

## Characteristics:

pleasant fruity odor  
 sweet taste plum flavor  
 most intense aroma

Formula Weight: 116.2

Boiling Point: 123.5° C. (at 760 mm.)

Specific Gravity: 0.871(20/4)

Refractive Index: 1.391

## Uses:

synthetic apple, apricot, lemon,  
 orange, pear, plum, raspberry,  
 strawberry, and woodruff flavors

Solubility (grams per 100 ml.):

0.307 (in water) at 22° C.  
 very soluble in alcohol  
 $\infty$  (in ether)

## ISOAMYL FUROATE

## Synonyms:

furoic acid isoamyl ester  
 2-furoic acid isoamyl ester  
 isoamyl pyromucate

Formula:  $\text{C}_4\text{H}_3\text{OCOOC}_5\text{H}_{11}$

Formula Weight: 182.2

Boiling Point: 135 to 137° C. (at 25 mm.)

## Solubility:

insoluble in water  $\infty$  (in alcohol)

## ISOAMYL ISOBUTYRATE

## Synonyms:

amyl isobutyrate  
 isobutyric acid isoamyl ester  
 $\gamma$ -methylbutyl 2-methylpropanoate

Formula:  $(\text{CH}_3)_2\text{CHCOOC}_5\text{H}_{11}$

## Characteristics:

agreeably fruity odor which on dilution  
 has an odor of banana and pineapple  
 sweet taste pineapple flavor

Formula Weight: 158.2

Boiling Point: 168.8° C. (at 760 mm.)

## Specific Gravity:

0.865 to 0.867 0.876(0/4)

## Uses:

synthetic blackberry, cocoa, currant,  
 date, hops, melon, orange, peach,  
 pineapple, plum, strawberry,  
 tangerine, and woodruff flavors

## Solubility:

very slightly soluble in water  
 soluble in alcohol soluble in ether

## ISOAMYL ISOCYANIDE

## Synonyms:

isoamyl carbylamine  
 isocaproic isonitrile  
 $\gamma$ -methylbutyl isocyanide

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{NC}$

Formula Weight: 97.2

Boiling Point: 137 to 139° C. (at 760 mm.)

## Solubility:

insoluble in water soluble in alcohol  
 soluble in ether

## ISOAMYL ISOTHIOCYANATE

## Synonyms:

isothiocyanic acid isoamyl ester  
 $\gamma$ -methylbutyl isothiocyanate  
 amyl mustard oil

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{NCS}$

Characteristics: yellow

Formula Weight: 129.2

Boiling Point: 182 to 184° C. (at 760 mm.)

Specific Gravity: 0.942(20/4)

## ISOAMYL ISOTHIOCYANATE (Cont.)

## Solubility:

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether

## ISOAMYL ISOVALERATE

## Synonyms:

amyl isovalerianate  
 isovaleric acid isoamyl ester  
 $\gamma$ -methylbutyl 3-methylbutanoate  
 amyl valerate

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COOC}_5\text{H}_{11}$

## Characteristics:

pleasant fruity odor which on dilution  
 resembles ripe apples  
 sweet taste apple flavor

Formula Weight: 172.3

Boiling Point: 191 to 194°C. (at 760 mm.)

## Specific Gravity:

0.8584(12/0) 0.858(20/15)  
 0.870 at 0°C.

Refractive Index: 1.41311 at 19°C.

## Uses:

perfumery modifier  
 synthetic apple, apricot, blackberry,  
 black cherry, date, grape, grenadine,  
 honey, melon, peach, pear, pineapple,  
 quince, raspberry, strawberry, and  
 walnut flavors

## Solubility:

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether

## ISOAMYL METHYL ETHER

Formula:  $\text{CH}_3\text{OC}_5\text{H}_{11}$

Formula Weight: 102.2

Boiling Point: 91°C. (at 765 mm.)

Specific Gravity: 0.687(91/4)

## ISOAMYL NAPHTHALENE

Formula:  $\text{C}_5\text{H}_{11}\text{C}_{10}\text{H}_7$

Formula Weight: 198.3

Melting Point: < -21°C.

Boiling Point: 288 to 292°C. (at 760 mm.)

Specific Gravity: 0.973 at 0°C.

## Solubility:

insoluble in water soluble in alcohol  
 soluble in ether

## ISOAMYL 2-NAPHTHYL ETHER

## Synonyms:

2-( $\gamma$ -methylbutoxy) naphthalene

Formula:  $\text{C}_{10}\text{H}_7\text{OCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 214.3

Melting Point: 26.5°C.

## Boiling Point:

323 to 326°C. (at 760 mm.) decompose

Specific Gravity: 1.0155(12/4)

Refractive Index: 1.5768 at 12°C.

## Solubility:

insoluble in water soluble in alcohol  
 soluble in ether

## ISOAMYL NITRATE

Synonyms:  $\gamma$ -methylbutyl nitrate

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{ONO}_2$

Formula Weight: 133.2

Boiling Point: 147 to 148°C. (at 760 mm.)

Specific Gravity: 0.996 at 22°C.

Refractive Index: 1.41219 at 21.7°C.

## Solubility:

very slightly soluble in water  
 slightly soluble in alcohol  
 slightly soluble in ether

## ISOAMYL NITRITE

Synonyms:  $\gamma$ -methylbutyl nitrite

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{ONO}$

Characteristics:

yellow                      inflammable  
fragrant penetrating odor

Formula Weight: 117.2

Boiling Point: 97 to 99° C. (at 760 mm.)

Specific Gravity:

0.875(25/25)                      0.872(20/4)

Refractive Index: 1.38708 at 20.7° C.

Uses:

antidote for various poisons  
vasodilator                      antispasmodic

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## ISOAMYL OLEATE

Synonyms: oleic acid isoamyl ester

Formula:  $\text{C}_{17}\text{H}_{33}\text{COO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 352.6

Boiling Point: 233 to 234° C. (at 10 mm.)

Specific Gravity: 0.897 at 15° C.

Solubility:

insoluble in water      soluble in alcohol  
very soluble in ether

## ISOAMYL OXALATE

Synonyms:

diisoamyl oxalate  
bis ( $\gamma$ -methylbutyl) ethanedioate  
oxalic acid isisoamyl ester

Formula:  $(\text{COOC}_5\text{H}_{11})_2$

Formula Weight: 230.3

Boiling Point: 265 to 267° C. (at 760 mm.)

Specific Gravity: 0.968(11/11)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## ISOAMYL PHENYL ETHER

Synonyms:

isoamoxybenzene  
3-methyl-1-phenoxybutane

Formula:  $\text{C}_6\text{H}_5\text{O}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$

Characteristics: oily

Formula Weight: 164.2

Boiling Point: 224 to 225° C. (at 760 mm.)

Specific Gravity: 0.9198(22/4)

Refractive Index: 1.4872 at 20° C.

Solubility:

insoluble in water      soluble in alcohol  
   soluble in ether

## ISOAMYL PHTHALATE

Synonyms:

diisoamyl phthalate  
phthalic acid diisoamyl ester

Formula:  $\text{C}_6\text{H}_4(\text{COOC}_5\text{H}_{11})_2$

Formula Weight: 306.4

Boiling Point: 225° C. (at 40 mm.)

Specific Gravity: 1.03

Solubility:

insoluble in water      soluble in alcohol  
   soluble in ether

## ISOAMYL PROPIONATE

Synonyms:

$\gamma$ -methylbutyl propanoate  
propionic acid isoamyl ester

Formula:  $\text{CH}_3\text{CH}_2\text{COOC}_5\text{H}_{11}$

Characteristics:

distinct fruity odor of pineapple and  
pear  
bitter-sweet taste  
apricot-plum flavor

Formula Weight: 144.2

Boiling Point: 160.2° C. (at 760 mm.)

Specific Gravity: 0.870(20/4)

Refractive Index: 1.4065

## ISOAMYL PROPIONATE (Cont.)

## Uses:

synthetic apricot, arrack, lemon,  
orange, pear, pineapple, plum,  
quince, raspberry, strawberry,  
and woodruff flavors

## Solubility (grams per 100 ml.):

0.09 (in water) at 25°C.  
very soluble in alcohol  
very soluble in ether

## ISOAMYL PROPYL ETHER

Synonyms: 3-methyl-1-propoxybutane

Formula:  $C_3H_7OC_5H_{11}$

Formula Weight: 130.2

Boiling Point: 130°C. (at 760 mm.)

## Solubility:

insoluble in water     $\infty$  (in ether)  
soluble in alcohol

## ISOAMYL SALICYLATE

## Synonyms:

isoamyl *o*-hydroxybenzoate  
salicylic acid isoamyl ester

Formula:  $HOC_6H_4COOC_5H_{11}$

## Characteristics:

colorless to yellow  
bitter-sweet taste  
strawberry flavor  
fragrant clover and orchid-like  
aromatic odor

Formula Weight: 208.3

## Boiling Point:

273°C. (at 760 mm.)  
280°C. (at 760 mm.)  
128 to 130°C. (at 12 mm.)

## Specific Gravity:

1.045(25/25)                      1.042(25/4)

## Refractive Index:

1.505                                  1.507

## Uses:

perfume fixative  
synthetic date, grenadine, raspberry,  
and strawberry flavors

## Solubility (grams per 100 ml.):

0.004 (in water) at 22°C.  
very soluble in alcohol  
very soluble in chloroform  
 $\infty$  (in ether)

## Solubility in Water-Alcohol Mixtures

% Alcohol	Ratio
45	1:1000
70	1:100
80	2:7
90	1:1

## Additional Data:

optical rotation  $[\alpha] +1^\circ 30'$

## ISOAMYL STEARATE

## Synonyms:

$\gamma$ -methylbutyloctadecanoate  
stearic acid isoamyl ester

Formula:  $CH_3(CH_2)_{16}COOC_5H_{11}$

Formula Weight: 254.6

Melting Point: 21 to 23°C.

Boiling Point: 185 to 190°C. (at 1 mm.)

Specific Gravity: 0.855(20/4)

## Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## ISOAMYL SUCCINATE

## Synonyms:

diisoamyl succinate  
succinic acid diisoamyl ester

Formula:  $(CH_2COOC_5H_{11})_2$

Formula Weight: 258.4

Boiling Point: 289.9°C. (at 728 mm.)

Specific Gravity: 0.961 at 13°C.

## Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## ISOAMYL SULFIDE

## Synonyms:

diisoamyl sulfide

3-methyl-1-( $\gamma$ -methylbutylthio)-butaneFormula:  $[(CH_3)_2CH(CH_2)_2]_2S$ 

Formula Weight: 174.3

## Boiling Point:

216° C. (at 760 mm.)

209 to 211° C. (at 760 mm.)

Specific Gravity: 0.84314(20/4)

Refractive Index: 1.45238

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## ISOAMYL TARTRATE

## Synonyms:

diisoamyl tartrate

tartaric acid isoamyl ester

Formula:  $(HOCHCOOC_5H_{11})_2$ 

Formula Weight: 290.4

Boiling Point: 195° C. (at 16 mm.)

Specific Gravity: 1.063(14.8/4)

Solubility: insoluble in water

## ISOAMYL THIOCYANATE

## Synonyms:

isoamyl rhodanate

isoamyl sulfocyanate

thiocyanic acid isoamyl ester

Formula:  $(CH_3)_2CHCH_2SCN$ 

Characteristics: pale yellow

Formula Weight: 129.2

## Boiling Point:

197° C. (at 760 mm.)

193.5 to 195° C. (at 740 mm.)

Specific Gravity: 0.905

## Solubility:

very slightly soluble in water

soluble in alcohol    soluble in ether

## ISOBUTYL ACETATE

## Synonyms:

acetic acid isobutyl ester

 $\beta$ -methylpropyl ethanoateFormula:  $CH_3COOCH_2CH(CH_3)_2$ 

## Characteristics:

strong fruity odor less delicate than

that of ethyl butyrate

bitter, burning taste

pineapple flavor

Formula Weight: 116.2

Melting Point: -98.9° C.

## Boiling Point:

116.5° C. (at 760 mm.)

115 to 117° C. (at 760 mm.)

118° C. (at 760 mm.)

106 to 117° C. (at 760 mm.)

114 to 118° C. (at 760 mm.)

## Specific Gravity:

0.8712(20/4)

0.8685 at 15° C.

0.870 at 20° C.

7.24 lbs. per gal. at 20° C.

## Refractive Index:

1.39114 at 17.8° C.

1.3997 at 20° C.

## Flash Point:

88° F. (open)

64° F. (closed)

## Uses:

solvent for nitrocellulose

synthetic apple, apricot, banana,

butter, mirabelle-plum, pineapple,

rum, and strawberry flavors

## Solubility (grams per 100 ml.):

1.64 (of water)

0.63 (in water) at 25° C.

 $\infty$  (in alcohol)     $\infty$  (in ether)

one volume dissolves in:

180 volumes of water,

10 volumes of 45% alcohol,

1 volume of 90% alcohol

## Additional Data:

coefficient of expansion,

0.00119 at 10 to 30° C.

dilution ratio,

with toluene . . . . . 2.7

with petroleum naphtha . . . . 1.1

vapor density, 4.00

## ISOBUTYL ALCOHOL

## Synonyms:

isopropyl carbinol      isobutanol  
2-methyl-1-propanol

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ 

Characteristics: inflammable

Formula Weight: 74.1

Melting Point:  $-108^\circ\text{C}$ .

## Boiling Point:

108.39 $^\circ\text{C}$ . (at 760 mm.)  
106 to 108 $^\circ\text{C}$ . (at 760 mm.)  
107 to 111 $^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.805 at 17.5 $^\circ\text{C}$ .      0.803 at 20 $^\circ\text{C}$ .  
0.8169  
6.86 lbs. per gal. at 20 $^\circ\text{C}$ .

## Refractive Index:

1.3968 at 17.5 $^\circ\text{C}$ .      1.396 at 20 $^\circ\text{C}$ .

Inflammability Range (volume per cent  
in air): 1.68 (lower limit)

## Flash Point:

111 $^\circ\text{F}$ . (open)      82 $^\circ\text{F}$ . (closed)

## Uses:

dye intermediate      dyes  
organic syntheses      perfumes  
fruit essences      paint removers

## Solubility (grams per 100 ml.):

16.9 (of water)  
10 (in water) at 15 $^\circ\text{C}$ .  
9.5 (in water) at 18 $^\circ\text{C}$ .  
 $\infty$  (in alcohol)       $\infty$  (in ether)

## Additional Data:

weight of pure vapor, 3300 mg./*l*.  
vapor density,  
2.56      2.55  
coefficient of expansion,  
0.00095 at 10 to 30 $^\circ\text{C}$ .  
autoignition temperature, 825 $^\circ\text{F}$ .  
critical temperature, 265 $^\circ\text{C}$ .  
critical pressure, 48 atm.

## ISOBUTYLAMINE

## Synonyms:

1-amino-2-methylpropane  
monoisobutylamine

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{NH}_2$ 

Characteristics:

amine odor      strongly alkaline

Formula Weight: 73.1

Melting Point:  $-85.5^\circ\text{C}$ .

## Boiling Point:

66 to 69 $^\circ\text{C}$ . (at 760 mm.)  
67 to 69 $^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.732(20/20)      0.733(20/20)  
0.736

Refractive Index: 1.39878 at 17.0 $^\circ\text{C}$ .Viscosity (centipoises): 0.55 at 25 $^\circ\text{C}$ .Flash Point: <200 $^\circ\text{F}$ . (open)

## Uses:

organic syntheses      intermediates  
insecticides

## Solubility:

$\infty$  (in water)       $\infty$  (in ether)  
 $\infty$  (in alcohol)  
soluble in methyl alcohol, acetone,  
benzene, ethyl acetate, gasoline,  
and hydrocarbons

## Additional Data:

coefficient of expansion,  
0.00154 per  $^\circ\text{C}$ .

p-ISOBUTYLANILINEFormula:  $\text{C}_4\text{H}_9\text{C}_6\text{H}_4\text{NH}_2$ 

Characteristics: pale yellow

Formula Weight: 149.2

Boiling Point: 235 $^\circ\text{C}$ . (at 762 mm.)

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ISOBUTYLBENZENE

Synonyms: 2-methyl-1-phenylpropane

Formula:  $C_6H_5CH_2CH(CH_3)_2$

Formula Weight: 134.2

Boiling Point:

170.5° C. (at 760 mm.)

171.4° C. (at 760 mm.)

Specific Gravity: 0.8673(20/4)

Refractive Index: 1.4957 at 14.5° C.

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## ISOBUTYL BENZOATE

Synonyms:

benzoic acid isobutyl ester

$\beta$ -methylpropyl benzenecarboxylate

Formula:  $C_6H_5COOCH_2CH(CH_3)_2$

Characteristics:

unpleasant odor  
oily

bitter taste  
caraway flavor

Formula Weight: 178.2

Boiling Point:

237° C. (at 760 mm.)

241.5° C. (at 760 mm.)

Specific Gravity:

0.997(25/25) 1.002(15/4)

Uses:

synthetic caraway type flavors

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ISOBUTYL BORATE

Synonyms: triisobutyl borate

Formula:  $B(OC_4H_9)_3$

Formula Weight: 230.2

Boiling Point: 212° C. (at 760 mm.)

Specific Gravity: 0.864(0/4)

Refractive Index: 1.408

## ISOBUTYL BUTYRATE

Synonyms:

butyric acid isobutyl ester

$\beta$ -methylpropyl butyrate

Formula:  $CH_3(CH_2)_2COOCH_2CH(CH_3)_2$

Characteristics:

agreeably fruity odor

sweet taste

rum flavor

Formula Weight: 144.2

Boiling Point: 156.9° C. (at 760 mm.)

Specific Gravity:

0.863(18/4) 0.8606(25/4)

Refractive Index: 1.4035

Uses:

synthetic arrack, brandy, and rum  
flavors

Solubility:

very slightly soluble in water

$\infty$  (in alcohol)  $\infty$  (in ether)

## ISOBUTYL CARBONATE

Synonyms:

diisobutyl carbonate

carbonic acid diisobutyl ester

Formula:  $CO[OCH_2CH(CH_3)_2]_2$

Formula Weight: 174.2

Boiling Point: 190.3° C. (at 760 mm.)

Specific Gravity: 0.919(15/4)

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ISOBUTYL CHLOROFORMATE

Synonyms:

chloroformic acid isobutyl ester

isobutyl chlorocarbonate

$\beta$ -methyl propyl chloromethanoate

Formula:  $ClCOOCH_2CH(CH_3)_2$

Formula Weight: 136.6

## ISOBUTYL CHLOROFORMATE (Cont.)

## Boiling Point:

128.8° C. (at 760 mm.)

130° C. (at 760 mm.)

## Specific Gravity:

1.045(18.5/15)

1.037(25/4)

## Solubility:

decomposes in water

soluble with decomposition in alcohol

very soluble in chloroform

soluble in benzene

∞ (in ether)

## ISOBUTYL CROTONATE

Synonyms: crotonic acid isobutyl ester

Formula:  $\text{CH}_3\text{CH}:\text{CHCOOC}_4\text{H}_9$ 

## Characteristics:

pale yellow

oily

Formula Weight: 142.2

Boiling Point: 170 to 172° C. (at 760 mm.)

## ISOBUTYL ETHER

## Synonyms:

diisobutyl ether

(2-methyl-1-β-methyl propoxy)propane

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2]_2\text{O}$ 

Formula Weight: 130.2

Boiling Point: 122.5° C. (at 760 mm.)

Specific Gravity: 0.7616(15/4)

## Solubility:

slightly soluble in water

∞ (in alcohol)

∞ (in ether)

## ISOBUTYL FORMATE

## Synonyms:

formic acid isobutyl ester

β-methylpropyl methanoate

tetryl formate

Formula:  $\text{HCOOCH}_2\text{CH}(\text{CH}_3)_2$ 

## Characteristics:

strong ethereal, fruity, raspberry-like odor

very sweet taste rum flavor

Formula Weight: 102.1

Melting Point: -95.3° C.

Boiling Point: 98.2° C. (at 760 mm.)

## Specific Gravity:

0.885(20/4)

0.875(20/4)

Refractive Index: 1.38584 at 19.9° C.

## Uses:

synthetic arrack, blackberry, green gage, malt, mulberry, melon, mirabelle-plum, raspberry, rum and whisky flavors

Solubility (grams per 100 ml.):

1.01 (in water) at 22° C.

∞ (in alcohol)

∞ (in ether)

## Additional Data:

critical temperature, 278.0° C.

critical pressure, 38.0 atm.

## ISOBUTYL ISOBUTYRATE

## Synonyms:

isobutyric acid isobutyl ester

β-methylpropyl-2-methylpropanoate

Formula:  $(\text{CH}_3)_2\text{CHCOOCH}_2\text{CH}(\text{CH}_3)_2$ 

Characteristics: fruity odor

Formula Weight: 144.2

Melting Point: -80.7° C.

## Boiling Point:

148 to 149° C. (at 760 mm.)

148.7° C. (at 760 mm.)

147.5° C. (at 760 mm.)

Specific Gravity: 0.875(0/4)

Refractive Index: 1.3999

Uses: various synthetic fruit flavors

## Solubility:

very slightly soluble in water

very soluble in alcohol

∞ (in ether)

## ISOBUTYL ISOCYANIDE

## Synonyms:

isobutyl carbylamine  
 $\beta$ -methylpropylcarbylamine

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{NC}$

Formula Weight: 83.1

Melting Point:  $< -60^\circ\text{C}$ .

Boiling Point:  $114$  to  $117^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.787$  at  $4^\circ\text{C}$ .

## Solubility:

slightly soluble in water  
 soluble in alcohol      soluble in ether

## ISOBUTYL ISOTHIOCYANATE

## Synonyms:

isobutyl mustard oil  
 isothiocyanic acid isobutyl ester  
 $\beta$ -methylpropyl isothiocyanate

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{NCS}$

Formula Weight: 115.2

Boiling Point:  $162^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.9638$  at  $14^\circ\text{C}$ .

Refractive Index:  $1.5005$  at  $14^\circ\text{C}$ .

## Solubility:

insoluble in water       $\infty$  (in ether)  
 soluble in alcohol

## ISOBUTYL ISOVALERATE

## Synonyms:

isovaleric acid isobutyl ester  
 $\beta$ -methylpropyl 3-methylbutanoate

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COOCH}_2\text{CH}(\text{CH}_3)_2$

## Characteristics:

fruity ethereal odor with a valerian  
 note  
 sweet taste      apple flavor

Formula Weight: 158.2

## Boiling Point:

$169$  to  $172^\circ\text{C}$ . (at  $760$  mm.)  
 $168.5^\circ\text{C}$ . (at  $760$  mm.)

## Specific Gravity:

$0.874(0/4)$        $0.870$  to  $0.873$   
 $0.854(20/4)$

## Refractive Index:

$1.4064$        $1.4060$

## Uses:

perfume modifier  
 synthetic apple, apricot, cranberry,  
 date, honey, pear, quince, woodruff,  
 and strawberry flavors

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ISOBUTYL LACTATE

## Synonyms: lactic acid isobutyl ester

Formula:  $\text{CH}_3\text{CHOHCOOC}_4\text{H}_9$

Formula Weight: 146.2

Boiling Point:  $60$  to  $62^\circ\text{C}$ . (at  $7$  mm.)

Uses: solvent

## ISOBUTYL METHACRYLATE

## Synonyms:

methacrylic acid isobutyl ester

## Formula:

$\text{CH}_2:\text{C}(\text{CH}_3)\text{COOCH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 142.2

Boiling Point:  $155^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.889(15.6/15.6)$

Refractive Index:  $1.418$  at  $24^\circ\text{C}$ .

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## ISOBUTYL METHYLAMINE

## Synonyms: methyl isobutylamine

Formula:  $\text{CH}_3\text{NHC}_4\text{H}_9$

Formula Weight: 87.2

Boiling Point:  $76$  to  $78^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.722$  at  $18^\circ\text{C}$ .

## ISOBUTYL METHYL ETHER

Synonyms: 1-methoxy-2-methylpropane

Formula:  $\text{CH}_3\text{OCH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 88.2

Boiling Point:  $59^\circ\text{C}$ . (at 741 mm.)

Specific Gravity: 0.7507(0/4)

Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

## ISOBUTYL NITRATE

Synonyms:  $\beta$ -methylpropyl nitrateFormula:  $(\text{CH}_3)_2\text{CHCH}_2\text{ONO}_2$ 

Formula Weight: 119.1

Boiling Point:  $122.9^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.015(20/4)                      1.0168(20/20)

Refractive Index: 1.40130 at  $23.3^\circ\text{C}$ .

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## ISOBUTYL NITRITE

Synonyms:  $\beta$ -methylpropyl nitriteFormula:  $(\text{CH}_3)_2\text{CHCH}_2\text{ONO}$ 

Formula Weight: 103.1

Boiling Point:  $67$  to  $68^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8702(20/20)

Refractive Index: 1.37151 at  $22.1^\circ\text{C}$ .

Solubility:

insoluble in water    soluble in ether  
 very soluble in alcohol

## ISOBUTYL OXALATE

Synonyms:

diisobutyl oxalate  
 bis ( $\beta$ -methylpropyl) ethanedioate  
 oxalic acid diisobutyl ester

Formula:  $(\text{COOC}_4\text{H}_9)_2$ 

Formula Weight: 202.3

Boiling Point:

$228$  to  $229^\circ\text{C}$ . (at 760 mm.)  
 $229.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.002 at  $14^\circ\text{C}$ .

Solubility:

insoluble in water    soluble in alcohol  
                                  soluble in ether

## ISOBUTYL PHENYL ETHER

Synonyms:

isobutoxybenzene  
 2-methyl-1-phenoxypropane

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{OC}_6\text{H}_5$ 

Formula Weight: 150.2

Boiling Point:  $198^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.939(16/4)

## ISOBUTYL PROPIONATE

Synonyms:

$\beta$ -methylpropyl propanoate  
 propionic acid isobutyl ester

Formula:  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}(\text{CH}_3)_2$ 

Characteristics:

agreeably fresh fruity odor  
 bitter taste                      grape flavor

Formula Weight: 130.2

Melting Point:  $-71.4^\circ\text{C}$ .

Boiling Point:

$136$  to  $138^\circ\text{C}$ . (at 760 mm.)  
 $135$  to  $137^\circ\text{C}$ . (at 760 mm.)  
 $136^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.86 to 0.8635(20/20)  
 0.8876(0/4)

Refractive Index: 1.3975

Uses:

solvent for lacquers, paint, varnish,  
 synthetic apple, blackberry, cherry,  
 hops, ginger, grape, mulberry,  
 woodruff, and whisky essences

**Solubility:**

very slightly soluble in water  
 very soluble in alcohol  
 very soluble in ether

**ISOBUTYL PROPYL ETHER**

**Synonyms:** 2-methyl-1-propoxypropane

**Formula:**  $(\text{CH}_3)_2\text{CHCH}_2\text{O}(\text{CH}_2)_2\text{CH}_3$

**Formula Weight:** 116.2

**Boiling Point:** 105 to 106°C. (at 760 mm.)

**Solubility:**

insoluble in water     $\infty$  (in ether)  
 soluble in alcohol

**ISOBUTYL RICINOLEATE****Synonyms:**

$\beta$ -methylpropyl 12-hydroxy-1-octadecenoate  
 ricinoleic acid isobutyl ester

**Formula:**  $\text{C}_{18}\text{H}_{33}\text{O}_3\text{CH}_2\text{CH}(\text{CH}_2)_2$

**Formula Weight:** 354.6

**Boiling Point:** 262°C. (at 9 mm.)

**Specific Gravity:** 0.903 at 22°C.

**Refractive Index:** 1.4538 at 22°C.

**Solubility:**

insoluble in water    soluble in alcohol  
                               soluble in ether

**ISOBUTYL SUCCINATE****Synonyms:**

diisobutyl succinate  
 succinic acid diisobutyl ester  
 succinic acid isobutyl ester

**Formula:**  $(\text{CH}_2\text{COOC}_4\text{H}_9)_2$

**Formula Weight:** 230.3

**Boiling Point:** 264 to 266°C. (at 760 mm.)

**Specific Gravity:** 0.974 at 15°C.

**ISOBUTYL SULFATE**

**Synonyms:** diisobutyl sulfate

**Formula:**  $[(\text{CH}_3)_2\text{CHCH}_2]_3\text{SO}_4$

**Formula Weight:** 210.3

**Boiling Point:** 133 to 134°C. (at 19 mm.)

**Specific Gravity:** 1.042 at 23°C.

**Refractive Index:** 1.415

**ISOBUTYL SULFIDE****Synonyms:**

diisobutyl sulfide  
 2-methyl-1-( $\beta$ -methylpropylthio)-propane

**Formula:**  $[(\text{CH}_3)_2\text{CHCH}_2]_2\text{S}$

**Formula Weight:** 146.3

**Boiling Point:** 172 to 173°C. (at 760 mm.)

**Specific Gravity:**

0.836 at 10°C.            0.8386(16/4)

**Solubility:**

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

**ISOBUTYL THIOCYANATE****Synonyms:**

isobutyl rhodanate  
 isobutyl sulfocyanate  
 thiocyanic acid isobutyl ester

**Formula:**  $(\text{CH}_3)_2\text{CHCH}_2\text{SCN}$

**Formula Weight:** 115.2

**Boiling Point:** 174 to 176°C. (at 760 mm.)

**Solubility:**

insoluble in water     $\infty$  (in alcohol)

**ISOBUTYL d-TOLUATE****Synonyms:**

eglantine  
 isobutyl phenylacetate  
d-toluic acid isobutyl ester

**Formula:**  $\text{C}_6\text{H}_5\text{CH}_2\text{COOC}_4\text{H}_9$

**Characteristics:**

rose-like odor  
 sweet taste  
 distinct honey flavor

ISOBUTYL  $\alpha$  - TOLUATE (Cont.)

Formula Weight: 192.3

Boiling Point:

254° C. (at 760 mm.)

247° C. (at 760 mm.)

128 to 131° C. (at 20 mm.)

Specific Gravity: 0.990 to 0.993

Uses:

honey flavors

butterscotch, date, and grenadine  
essences

Solubility:

insoluble in water

soluble in alcohol

one volume dissolves in 8 volumes of  
70% alcohol

soluble in ether

## ISOBUTYL URETHANE

Formula:  $C_4H_9CH_2COOC_4H_9$ 

Formula Weight: 145.2

Melting Point: &lt; -65° C.

Boiling Point: 95 to 96° C. (at 15 mm.)

Specific Gravity: 0.943(20/4)

Solubility:

insoluble in water    soluble in alcohol

## ISOBUTYL VALERATE

Synonyms:

 $\beta$ -methylpropyl pentanoate

valeric acid isobutyl ester

Formula:  $CH_3(CH_2)_3COOCH_2CH(CH_3)_2$ 

Formula Weight: 158.2

Boiling Point: 167° C. (at 760 mm.)

Specific Gravity: 0.854

Solubility:

insoluble in water     $\infty$  (in ether)  
 $\infty$  (in alcohol)

## ISOBUTYL VINYL ETHER

Synonyms: vinyl isobutyl ether

Formula:  $(CH_3)_2CHCH_2OCH:CH_2$ 

Characteristics: ethereal odor

Formula Weight: 100.2

Melting Point: -112° C.

Boiling Point:

82.9 to 83.2° C. (at 760 mm.)

Vapor Pressure: 1.3 psia. at 70° F.

Specific Gravity: 0.7644 at 25° C.

Refractive Index: 1.3938 at 25° C.

Flash Point: 20° F. (open)

Specific Heat (gram-calories per g.  
per ° C.): 0.555 (liquid) at 25° C.

Uses: organic syntheses

Solubility:

0.75% (of water) at 25° C.

&lt;0.1% (in water) at 25° C.

soluble in alcohol    soluble in ether

Additional Data:

the technical product contains  
triethanolamine as a stabilizing  
agent and can be purified by washing  
with water, drying with a neutral or  
alkaline agent, and treating with  
sodium

## ISOBUTYRALDEHYDE

Synonyms:

isobutyl aldehyde

isobutyryl aldehyde

2-methylpropanol

Formula:  $(CH_3)_2CHCHO$ 

Characteristics: penetrating odor

Formula Weight: 72.1

Melting Point: -65.9° C.

Boiling Point: 61 to 63.5° C. (at 760 mm.)

Specific Gravity: 0.7938(20/4)

Refractive Index: 1.37302

Flash Point: -40° F. (closed)

Uses:

synthetic bourbon and whisky flavors  
organic syntheses

## Solubility (grams per 100 ml.):

11 (in water)	$\infty$ (in chloroform)
$\infty$ (in alcohol)	$\infty$ (in benzene)
$\infty$ (in ether)	

## Additional Data:

autoignition temperature, 490° F.

## ISOBUTYRIC ACID

## Synonyms:

dimethylacetic acid  
2-methylpropanoic acid  
isopropylformic acid  
 $\alpha$ -methylpropionic acid

Formula:  $(\text{CH}_3)_2\text{CHCOOH}$

## Characteristics:

sharp odor which is less unpleasant  
than that of butyric acid  
oily

Formula Weight: 88.1

Melting Point: -47.0° C.

## Boiling Point:

154.4° C. (at 760 mm.)  
153 to 155° C. (at 760 mm.)

## Specific Gravity:

0.946 to 0.950(20/20)  
0.949(20/4)

Refractive Index: 1.39300

## Uses:

preparation of esters for solvents,  
flavors, and bases for perfumes  
disinfectant                      tanning agent

## Solubility (grams per 100 ml.):

20 (in water) at 20° C.  
 $\infty$  (in alcohol)                       $\infty$  (in chloroform)  
 $\infty$  (in ether)

## Additional Data:

critical temperature, 336° C.  
critical pressure, 40.0 atm.

## ISOBUTYRIC ANHYDRIDE

Formula:  $[(\text{CH}_3)_2\text{CHCO}]_2\text{O}$

Formula Weight: 158.2

Melting Point: -53.5° C.

Boiling Point: 182.5° C. (at 760 mm.)

Specific Gravity: 0.950(25/4)

## Solubility:

decomposes in water  
decomposes in alcohol  
 $\infty$  (in ether)

## ISOBUTYRONITRILE

## Synonyms:

isopropyl cyanide  
2-methylpropane nitrile

Formula:  $(\text{CH}_3)_2\text{CHCN}$

Formula Weight: 69.1

Boiling Point: 107 to 108° C. (at 760 mm.)

Specific Gravity: 0.773

## Solubility:

slightly soluble in water  
very soluble in alcohol  
very soluble in ether

## ISOBUTYROPHENONE

Synonyms: isopropyl phenyl ketone

Formula:  $(\text{CH}_3)_2\text{CHCOC}_6\text{H}_5$

Formula Weight: 148.2

## Boiling Point:

228.0° C. (at 760 mm.)  
217° C. (at 760 mm.)  
220° C. (at 746 mm.)

## Specific Gravity:

0.984                                      0.985(20/20)

Refractive Index: 1.51919 at 16.6° C.

## Solubility:

insoluble in water                      soluble in alcohol  
soluble in ether

## ISOBUTYRYL BROMIDE

Synonyms: 2-methyl propanoyl bromide

Formula:  $(\text{CH}_3)_2\text{CHCOBr}$

Formula Weight: 151.0

Boiling Point: 116 to 118° C. (at 760 mm.)

Specific Gravity: 1.4067 at 15° C.

## ISOBUTYRYL CHLORIDE

Synonyms: 2-methylpropanoyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCOCl}$

Formula Weight: 106.6

Melting Point:  $-90.00^\circ\text{C}$ .

Boiling Point:  $92^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.017(20/4)

Refractive Index: 1.4079

Solubility:

decomposes in water  
decomposes in alcohol  
soluble in ether

## ISOCAPROIC ACID

Synonyms:

isobutylacetic acid  
4-methylpentanoic acid  
2-methyl-5-pentanoic acid

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{COOH}$

Characteristics: oily

Formula Weight: 116.2

Melting Point:  $-35^\circ\text{C}$ .

Boiling Point:

$207.7^\circ\text{C}$ . (at 760 mm.)  
 $110$  to  $111^\circ\text{C}$ . (at 25 mm.)

Specific Gravity: 0.925(20/4)

Solubility:

slightly soluble in water  
soluble in alcohol    soluble in ether

## ISOCAPROICISONITRILE

Synonyms: isoamyl isocyanide

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{NC}$

Formula Weight: 97.2

Boiling Point:  $137$  to  $139^\circ\text{C}$ . (at 760 mm.)

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## ISOCAPRONITRILE

Synonyms:

caproic acid nitrile  
isoamyl cyanide  
isobutylacetoneitrile  
4-methylpentanenitrile

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{CN}$

Formula Weight: 97.2

Melting Point:  $-51.1^\circ\text{C}$ .

Boiling Point:  $155.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.804 to 0.806(20/4)

Refractive Index: 1.406

Solubility:

insoluble in water  
very soluble in alcohol  
 $\infty$  (in ether)

## ISOCAPROPHENONE

Synonyms: isoamyl phenyl ketone

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{COC}_6\text{H}_5$

Formula Weight: 176.3

Melting Point:  $24.7^\circ\text{C}$ .

Boiling Point:

$242.5^\circ\text{C}$ . (at 760 mm.)  
 $240$  to  $242^\circ\text{C}$ . (at 720 mm.)

Specific Gravity: 0.962(15/4)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## ISOCROTONYL CHLORIDE

Synonyms: isocrotyl chloride

Formula:  $(\text{CH}_3)_2\text{C}:\text{CHCl}$

Formula Weight: 90.6

Boiling Point:  $68^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.919(20/4)

Solubility (grams per 100 ml.):

$<0.1$  (in water)  
decomposes in hot water

## ISODURENE

Synonyms: 1, 2, 3, 5-tetramethylbenzene  
 Formula:  $(\text{CH}_3)_4\text{C}_6\text{H}_2$   
 Formula Weight: 134.2  
 Melting Point:  $-24^\circ\text{C}$ .  
 Boiling Point: 195 to  $197^\circ\text{C}$ . (at 760 mm.)  
 Specific Gravity:  
     0.891(20/4)              0.896(0/4)

Uses: organic synthesis

Solubility:  
     insoluble in water    soluble in alcohol  
     very soluble in ether

## ISOENANTHIC ACID

Synonyms:  
      $\delta$ -methylcaproic acid  
     5-methylhexanoic acid  
     isoamylacetic acid  
     isoheptylic acid  
 Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{COOH}$   
 Characteristics: oily  
 Formula Weight: 130.2  
 Melting Point:  $< -25^\circ\text{C}$ .  
 Boiling Point:  
     211.5 to  $216^\circ\text{C}$ . (at 760 mm.)  
 Specific Gravity:  
     0.926(15/4)              0.912(19/19)  
     0.9138(21/4)

Solubility:  
     slightly soluble in water  
     very soluble in alcohol  
     very soluble in ether

## ISOEUGENOL

Synonyms:  
     2-methoxy-4-propenylphenol  
     4-propenylguaiacol  
 Formula:  $\text{CH}_3\text{CH}:\text{CHC}_6\text{H}_3(\text{OCH}_3)\text{OH}$   
 Characteristics:  
     clove odor finer than that of eugenol  
     clove flavor              bitter sweet taste  
     pale yellow              oily

Formula Weight: 164.2

Melting Point:  $-10^\circ\text{C}$ .

Boiling Point:  $267.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:  
     1.0839(25/25)              1.0910 at  $15^\circ\text{C}$ .  
     1.0852(20/4)

Refractive Index:  
     1.5680 at  $18^\circ\text{C}$ .              1.5739

Uses:  
     perfumes                      vanillin  
     synthetic apple, apricot, banana,  
     gooseberry, grape, plum, raspberry,  
     strawberry, and woodruff flavors

Solubility:  
     very slightly soluble in water  
     soluble in alcohol    soluble in ether  
     miscible with many organic solvents

Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
45	1:11
50	1:3
70	1:2
90	1:1

## ISOHEPTANES

Synonyms:  
     essentially a commercial mixture of  
     isomeric branched chain heptanes  
     contains appreciable amounts of cyclo-  
     hexane, methylcyclopentane, and  
     dimethylcyclopentanes and small  
     amounts of benzene

Boiling Point:  $80$  to  $91^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure: 3.2 psia. at  $100^\circ\text{F}$ .

Specific Gravity:  
     0.725(60/60) $^\circ\text{F}$ .  
     6.03 lbs. per gal. at  $60^\circ\text{F}$ .

Refractive Index: 1.401

Flash Point:  $<0^\circ\text{F}$ . (open)

Uses:  
     selective solvent  
     conventional petroleum naphtha and  
     fuel applications  
     extractions                      crystallizations

## ISOHEPTANES (Cont.)

## Additional Data:

API gravity at 60° F., 63.7  
 kauri butanol value, 37.9 ml.  
 kauri solvent power, 13  
 aniline point, 125.1° F.  
 dimethyl sulfate value, 7%  
 nitrocellulose dilution ratio, 1.59

## ISOHEPTENES

## Synonyms:

a commercial mixture of branched  
 chain heptenes

Boiling Point: 68 to 98° C. (at 760 mm.)

Vapor Pressure: 3.9 psia. at 100° F.

## Specific Gravity:

0.709(60/60)° F.  
5.90 lbs. per gal. at 60° F.

## Uses:

intermediate for the production of  
 the alcohol and halogen derivatives

## Additional Data:

polymerizes slowly with age  
 API gravity at 60° F., 68.0  
 kauri butanol value, 37.7 ml.  
 solvent power, 12  
 bromine number, 140

## ISOHEXANES

## Synonyms:

a commercial mixture of 2- and  
 3-methylpentanes with small amounts  
 of hexane isomers, cyclopentane and  
 methylcyclopentane

Boiling Point: 57 to 61° C. (at 760 mm.)

Vapor Pressure: 7.3 psia. at 100° F.

## Specific Gravity:

0.669(60/60)° F.  
5.57 lbs. per gal. at 60° F.

Refractive Index: 1.375

Flash Point: <-200° F. (open)

## Uses:

selective solvent	crystallizations
fuel blends	extractions

## Additional Data:

API gravity at 60° F., 80.0  
 kauri butanol value, 27.7 ml.  
 solvent power, 2  
 dimethyl sulfate value, 7  
 nitrocellulose dilution ratio, 1.48

## ISOHEXYL ACETATE

Synonyms: acetic acid isohexyl ester

Formula:  $\text{CH}_3\text{COO}(\text{CH}_2)_3\text{CH}(\text{CH}_3)_2$

Formula Weight: 144.2

Boiling Point: 159° C. (at 755 mm.)

## Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

## ISOHEXYLBENZENE

Synonyms: 4-methyl-1-phenylpentane

Formula:  $\text{C}_6\text{H}_5(\text{CH}_2)_3\text{CH}(\text{CH}_3)_2$

Formula Weight: 162.3

Boiling Point: 214 to 215° C. (at 760 mm.)

Specific Gravity: 0.857

## Solubility:

insoluble in water    soluble in ether  
 slightly soluble in alcohol

## ISOOCTANES

## Synonyms:

the commercial product is fractionated  
 from natural gasoline and contains  
 isomeric branched chain octanes  
 appreciable amounts of various cyclo-  
 paraffins, and low amounts of toluene.  
 2,2,4-trimethylpentane is not present  
 in large amounts

Boiling Point: 102 to 113° C. (at 760 mm.)

Vapor Pressure: 1.3 psia. at 100° F.

## Specific Gravity:

0.751(60/60)° F.  
6.25 lbs. per gal. at 60° F.

Refractive Index: 1.415

Flash Point: 100° F. (open)

Uses:  
aviation fuels      selective solvent

Additional Data:  
API gravity at 60° F., 56.9  
kauri butanol value, 40.8 ml.  
solvent power, 16  
aniline point, 117.5° F.  
dimethyl sulfate value, 6%  
nitrocellulose dilution ratio, 1.63

ISO OCTENES

Synonyms:  
the commercial product consists  
chiefly of branched chain heptenes  
and octenes

Boiling Point: 88 to 149° C. (at 760 mm.)

Vapor Pressure: 2.0 psia. at 100° F.

Specific Gravity:  
0.726(60/60)° F.  
6.04 lbs. per gal. at 60° F.

Uses:  
alkylation of aromatic hydrocarbons  
polymerizations

Additional Data:  
polymerizes slowly with age  
API gravity at 60° F., 63.5  
kauri butanol value, 38.3 ml.  
solvent power, 13  
bromine number, 137

ISO OCTENE (commercial)

Composition:  
olefin content . . . . . 98+%  
trimethylpentenes . . 86%  
lighter compounds . . 7%  
heavier compounds . . 7%  
oxidation stabilizer . trace

Formula Weight: 112.5

Melting Point: < -76° F.

Boiling Point: 176 to 270° F. (at 760 mm.)

Specific Gravity:  
61.5° API                      6.1 lbs. per gal.  
0.733(60/60)° F.

Refractive Index: 1.4187

Flash Point: 300° F. (open)

Uses:  
special solvent      organic syntheses

Additional Data:  
octane, number, 82.5  
is somewhat unstable in presence of  
oxygen

ISO OCTENE (research grade)

Composition:  
olefin content . . . . . 99+%  
trimethylpentenes . . 89%  
dimethylhexenes . . . 10%  
other isooctenes . . . 1%  
oxidation stabilizer . 0.01%

Formula Weight: 112.2

Melting Point: < -76° F.

Boiling Point: 212 to 240° F. (at 760 mm.)

Specific Gravity:  
60.9° API                      0.735(60/60)° F.

Refractive Index: 1.4200

Flash Point: 320° F. (open)

Uses:  
solvent                      organic syntheses

Additional Data:  
is somewhat unstable in presence of  
light or oxygen

ISOPHORONE

Synonyms:  
3, 5, 5-trimethyl-2-cyclohexen-1-one  
1, 1, 3-trimethyl-cyclohexene-3-one-5

Formula: COCH:C(CH<sub>3</sub>)CH<sub>2</sub>C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>

Formula Weight: 138.2

Melting Point: -12° C.

Boiling Point:  
215 to 216° C. (at 760 mm.)  
215.2° C. (at 760 mm.)

Specific Gravity:  
0.923(20/20)  
7.7 lbs. per gal. at 20° C.

## ISOPHORONE (Cont.)

## Flash Point:

205° F. (open)      >175° F. (closed)

Heat of Vaporization (gram-calories per g.): 74.0

## Uses:

solvent for fats, gums, oils, resins,  
nitrocellulose, vinylite resins, inks,  
stencil plates, and roll coating  
finishes

organic syntheses

high boiling solvent for lacquers

Solubility (grams per 100 ml.):

4.3 (of water)      1.2 (in water)

## Additional Data:

nitrocellulose dilution ratios:

with toluene. . . . . 6.2

with xylene . . . . . 5.1

## ISOPRENE

## Synonyms:

hemiterpene

2-methyl-1, 3-butadiene

$\beta$ -methylbivinyll

$\beta$ -methyldivinyl

2-methylbutadiene-1, 3

Formula:  $\text{CH}_2\text{:CHC}(\text{CH}_3)\text{:CH}_2$

Formula Weight: 68.1

Melting Point:

-120° C.      -146.7° C.

Boiling Point:

34° C. (at 760 mm.)

32.6° C. (at 760 mm.)

Specific Gravity:

0.6989(0/0)      0.6806(20/4)

0.6768(15/15)

Refractive Index:

1.4221 at 18.3° C.      1.4216 at 20° C.

Specific Heat (Btu. per lb. per ° F.):

0.538 (liquid) at 77° F.

Heat of Vaporization (Btu. per lb.): 163.4

Uses: synthetic rubber

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
    $\infty$  (in ether)

## Additional Data:

specific gravity of gas (ideal,  
air = 1.0), 2.3515

specific gravity of liquid (in vacuo),  
0.6808(20/4)° C.      0.6861(60/60)° F.

API gravity at 60° F., 74.7

liquid density (in vacuo) at 60° F., 5.72

coefficient of expansion,

0.00085 at 60 to 77° F.

total heating values (at 77° F.),

20,600 Btu./lb.,

113,100 Btu./cu. ft. of gas

 $\beta$ -ISOPROPOXYPROPIONITRILE

Synonyms:  $\beta$ -isopropoxynitrile

Formula:  $(\text{CH}_3)_2\text{CHOCH}_2\text{CH}_2\text{CN}$

Formula Weight: 113.0

Freezing Point: -67° C.

Boiling Point:

65 to 65.5° C. (at 10 mm.)

82 to 86° C. (at 25 mm.)

Specific Gravity: 0.9085 at 25° C.

Refractive Index: 1.4064

Flash Point: 155° F. (closed)

## Uses:

selective solvent      organic syntheses

Solubility (grams per 100 ml.):

6.4 (in water)

soluble in alcohol, ether, benzene, and  
naphtha

## ISOPROPYL ACETATE

Synonyms: acetic acid isopropyl ester

Formula:  $\text{CH}_3\text{COOCH}(\text{CH}_3)_2$

Characteristics:

pleasant, fruity, aromatic odor

sweet taste      apple flavor

Formula Weight: 102.1

Melting Point: -73.4° C.

## Boiling Point:

88.4° C. (at 760 mm.)  
 89° C. (at 760 mm.)  
 88 to 90° C. (at 760 mm.)  
84 to 94° C. (at 760 mm.)

## Specific Gravity:

0.877(16/4)                      0.8690(25/4)  
 0.874(20/20)                    0.8719(20/4)  
0.870 at 20° C.  
7.3 lbs. per gal. at 20° C.

Refractive Index: 1.3770 at 20° C.

## Surface Tension (dynes per cm.):

24.5 at 25° C.

Viscosity (poises): 0.00525 at 20° C.

## Inflammability Range (volume per cent in air):

1.8 (lower limit)              7.8 (upper limit)

## Flash Point:

60° F., 45° F., 54° F. (open)  
40° F., 43° F. (closed)

## Specific Heat (gram-calories per g. per ° C.):

0.521 (liquid) at 15 to 25° C.

## Heat of Vaporization (gram-calories per g.):

73.9  
78.2 at the boiling point

## Uses:

solvent for nitrocellulose, oils and resins for lacquers, lacquer thinners, fats, waxes, gums, artificial leather and silk, dopes, films, and plastics organic syntheses artificial apple, banana, currant, grape, peach, and pear flavors

## Solubility (grams per 100 ml.):

1.8 (of water)  
3.09 (in water) at 20° C.  
 ∞ (in alcohol)                  ∞ (in ether)  
 miscible with most organic solvents

## Additional Data:

azeotrope with water boils at 76.6° C. and contains 89.4% isopropyl acetate by weight  
 coefficient of expansion,  
0.000727 per ° F.    0.00132 per ° C.

## dilution ratios:

with toluene. . . . . 2.7  
 with petroleum naphtha . . . . 1.1  
 nitrocellulose dilution ratio, 3.0  
 autoignition temperature, 860° F.  
 vapor density, 3.52

## ISOPROPYL ACETOACETATE

## Synonyms:

acetoacetic acid isopropyl ester

Formula:  $\text{CH}_3\text{C}\ddot{\text{O}}\text{CH}_2\text{COOCH}(\text{CH}_3)_2$

Formula Weight: 144.2

Boiling Point: 185 to 187° C. (at 760 mm.)

## Solubility:

very slightly soluble in water  
 soluble in alcohol      soluble in ether

## ISOPROPYL ALCOHOL

## Synonyms:

dimethylcarbinol      isopropanol  
 2-propanol                  propanol-2  
 secondary propyl alcohol  
 pseudopropyl alcohol

Formula:  $\text{CH}_3\text{CHOHCH}_3$

## Characteristics:

pleasant, characteristic odor having some similarity to the odor of acetone but with a fruity note  
 bitter-sweet taste      mobile liquid  
 apple flavor              inflammable

Formula Weight: 60.1

## Melting Point:

-89.5 to -88.5° C.      -81 to -83° C.  
 -85.8° C.

Boiling Point: 82.3° C. (at 760 mm.)

## Specific Gravity:

0.7862(20/20)                  0.783 to 0.789  
0.7854(20/4)  
6.6 lbs. per gal. at 20° C.

## Refractive Index:

1.37757                      1.3780

## Surface Tension (dynes per cm.):

21.7 at 20° C.

## ISOPROPYL ALCOHOL (Cont.)

Viscosity (poises): 0.0215 at 24.4° C.

Inflammability Range (volume per cent in air): 2.6 (lower limit)

Flash Point:

70° F. (open)      56° F. (closed)

Specific Heat (gram-calories per g. per ° C.): 0.595 (liquid) at 20° C.

Heat of Vaporization (gram-calories per g.): 159.2

Heat of Fusion (gram-calories per g.): 21.4

Heat of Combustion (gram-calories per g.): 7950 (liquid)

Uses:

solvent for alkaloids, gums, oils, shellac, many organic compounds, and for food flavors  
germicide  
rubbing compositions  
antiseptics, lotions, liniments, liquid soaps, and mouth washes  
purification of white oils  
organic syntheses  
anti-freeze mixtures  
high latent solvent power for nitro-cellulose and cellulose esters  
artificial apple, apricot, banana, currant, gooseberry, and raspberry flavors

Solubility:

∞ (of water)      ∞ (in alcohol)  
∞ (in water)      ∞ (in ether)  
miscible with the common lacquer solvents

Additional Data:

azeotrope with water boils at 80.2° C. and contains 87.7% isopropyl alcohol by weight  
coefficient of expansion, 0.000630 per ° F.  
0.00107 at 10 to 30° C.  
autoignition temperature, 852° F.  
vapor density, 2.07  
electrical conductivity, 35 x 10<sup>-7</sup> mhos at 25° C.

## ISOPROPYLAMINE

Synonyms:

2-aminopropane  
monoisopropylamine

Formula: (CH<sub>3</sub>)<sub>2</sub>CHNH<sub>2</sub>

Characteristics: amine odor

Formula Weight: 59.1

Melting Point: -101.2° C.

Boiling Point:

31.9° C. (at 760 mm.)  
33 to 34° C. (at 760 mm.)  
30.5 to 34.5° C. (at 760 mm.)

Specific Gravity:

0.694(15/4)	0.68 to
0.686(25/4)	<u>0.69(20/20)</u>
0.690(20/4)	
<u>5.7 lbs. per gal.</u>	

Refractive Index:

1.37678 at 15.4° C.    1.3763 at 20° C.

Viscosity (centipoises): 0.36 at 25° C.

Flash Point: -15° F. (open)

Uses:

organic syntheses    insecticides  
bactericides      pharmaceuticals  
dyes      rubber chemicals  
surface-active agents  
vulcanization accelerators  
photographic materials

Solubility:

∞ (in water)      ∞ (in ether)  
∞ (in alcohol)  
soluble in benzene, methyl alcohol, acetone, gasoline, ethyl acetate, and most organic solvents

Additional Data:

ionization constant, 5.3 x 10<sup>-4</sup>

pH of Aqueous Solutions  
(H electrode)

Normality	pH
1.0 . . . .	<u>12.36</u>
0.5 . . . .	<u>12.21</u>
0.1 . . . .	<u>11.81</u>
0.05 . . .	<u>11.64</u>
0.01 . . .	<u>11.28</u>
0.001 . . .	<u>10.61</u>



## ISOPROPYLCYCLOHEXANE (Cont.)

## Additional Data:

specific gravity of gas (ideal,  
air = 1.0), 4.3580  
specific gravity of liquid (in vacuo),  
0.80208(20/4)<sup>o</sup>C. 0.8063(60/60)<sup>o</sup>F.  
API gravity (at 60<sup>o</sup>F.), 44.0  
liquid density (in vacuo) at 60<sup>o</sup>F.,  
6.722  
aniline point, 120.0<sup>o</sup>F.  
coefficient of expansion,  
0.00053 at 32 to 104<sup>o</sup>F.  
total heating values (at 77<sup>o</sup>F.),  
19,954 Btu./lb.  
132,900 Btu./cu. ft. of gas

## ISOPROPYL ETHER

## Synonyms:

diisopropyl ether  
2-isopropoxypropane

Formula:  $(\text{CH}_3)_2\text{CHOCH}(\text{CH}_3)_2$

## Characteristics:

characteristic ethereal odor

Formula Weight: 102.2

## Melting Point:

-86.8<sup>o</sup>C. -60<sup>o</sup>C.

## Boiling Point:

67.5 to 69.0<sup>o</sup>C. (at 760 mm.)  
68.5<sup>o</sup>C. (at 760 mm.)  
65 to 70<sup>o</sup>C. (at 760 mm.)

## Specific Gravity:

0.7244(20/20) 0.7238(20/4)  
6.0 lbs. per gal. at 20<sup>o</sup>C.

Refractive Index: 1.3681 at 20<sup>o</sup>C.

Surface Tension (dynes per cm.): 32

Viscosity (centipoises): 0.379 at 25<sup>o</sup>C.

## Flash Point:

150 F., 170 F. (open)  
-18<sup>o</sup>F. (closed)

Specific Heat (gram-calories per g.  
per <sup>o</sup>C.): 0.333 (liquid) at 200 C.

Heat of Vaporization (gram-calories  
per g.): 68.2

Heat of Combustion (gram-calories  
per g.): 9380 (liquid)

## Uses:

solvent for animal, mineral, and  
vegetable oils, fats, waxes, and  
ethylcellulose  
a mixture with alcohol is a solvent for  
cellulose nitrate  
recovery of acetic acid from dilute  
aqueous solutions  
a mixture with acetone is a good  
dewaxing agent for paraffin base oils  
extraction of nicotine from tobacco  
partial solvent for spirit-soluble and  
oil-soluble dyes  
blending agent for aviation gasoline  
manufacture of celluloid articles,  
smokeless gunpowder, pharm-  
aceuticals, paint and varnish  
removers, rubber cements, and  
spotting compositions

## Solubility (grams per 100 ml.):

0.57 (of water) ∞ (in alcohol)  
0.90 (in water) ∞ (in ether)  
0.2 (in water)  
miscible with most organic solvents  
miscible with acetic acid

## Additional Data:

tends to form explosive peroxides and  
should not be distilled until the  
peroxides have first been destroyed  
azeotrope with water boils at 62.2<sup>o</sup>C.  
and contains 95.5% isopropyl ether  
by weight  
coefficient of expansion,  
0.000828 per <sup>o</sup>F.  
autoignition temperature, 830<sup>o</sup>F.  
vapor density, 3.52

## ISOPROPYL FORMATE

## Synonyms:

formic acid isopropyl ester  
isopropyl methanoate

Formula:  $\text{HCOOCH}(\text{CH}_3)_2$

## Characteristics:

volatile liquid  
pleasant, nonresidual fruity, ethereal  
odor  
very sweet taste plum flavor

Formula Weight: 88.1

Melting Point: < -80° C.

Boiling Point:  
71.3° C. (at 760 mm.)  
66.5 to 68.5° C. (at 760 mm.)  
68 to 70° C. (at 760 mm.)

Specific Gravity:  
0.883(0/4)                      0.876(25/25)  
0.873(20/4)

Refractive Index: 1.365 at 25° C.

Flash Point: 22° F. (closed)

Uses:  
synthetic lemon, orange, plum,  
raspberry, strawberry, and  
woodruff flavors

Solubility (grams per 100 ml.):  
2.1 (in water) at 22° C.  
∞ (in alcohol)  
∞ (in ether)  
∞ (in VMP naphtha)  
∞ (in benzene)  
∞ (in carbon tetrachloride)  
∞ (in methyl alcohol)

Additional Data:  
fire point, < -20° F.  
vapor density, 3.03

ISOPROPYL GLYCOLATE

Synonyms: glycolic acid isopropyl ester

Formula:  $\text{HOCH}_2\text{COOCH}(\text{CH}_3)_2$

Formula Weight: 118.1

Boiling Point: 161 to 162° C. (at 760 mm.)

Solubility:  
soluble in water, alcohol, and ether

ISOPROPYL ISOBUTYRATE

Synonyms:  
isobutyric acid isopropyl ester

Formula:  $(\text{CH}_3)_2\text{CHCOOCH}(\text{CH}_3)_2$

Characteristics:  
agreeably fruity odor  
sweet taste                      pineapple flavor

Formula Weight: 130.2

Boiling Point:  
120 to 121° C. (at 760 mm.)  
120.8° C. (at 760 mm.)

Specific Gravity: 0.869(0/4)

Uses:  
synthetic pineapple, raspberry, and  
strawberry flavors

Solubility:  
insoluble in water      soluble in alcohol  
soluble in ether

ISOPROPYL ISOCYANIDE

Synonyms:  
isocyanic acid isopropyl ester  
isopropylcarbylamine

Formula:  $(\text{CH}_3)_2\text{CHNC}$

Formula Weight: 69.1

Boiling Point: 87° C. (at 760 mm.)

Specific Gravity: 0.760 at 0° C.

Solubility:  
insoluble in water      ∞ (in alcohol)  
∞ (in ether)

ISOPROPYL ISOTHIOCYANATE

Synonyms:  
isopropyl mustard oil  
isothiocyanic acid isopropyl ester

Formula:  $(\text{CH}_3)_2\text{CHNCS}$

Formula Weight: 101.2

Boiling Point:  
137 to 137.5° C. (at 760 mm.)

ISOPROPYL ISOVALERATE

Synonyms: isovaleric acid isopropyl ester

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COOCH}(\text{CH}_3)_2$

Characteristics:  
fresh fruity odor      apple flavor  
sweet taste

Formula Weight: 144.2

Boiling Point: 142° C. (at 756 mm.)

## ISOPROPYL ISOVALERATE (Cont.)

Specific Gravity: 0.854 at 17° C.

## Uses:

synthetic apple, date, melon, and  
quince flavors

## ISOPROPYL LACTATE

## Synonyms:

isopropyl 2-hydroxypropanoate  
lactic acid isopropyl esterFormula:  $\text{CH}_3\text{CHOHCOOCH}(\text{CH}_3)_2$ 

## Formula Weight:

166 to 168° C. (at 760 mm.)

149 to 167° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 5 at 30° C.

## Specific Gravity:

0.988 at 20° C.

8.22 lbs. per gal. at 20° C.Flash Point: 130° F. (open)

## Solubility:

water is very soluble in this compound  
very soluble in water  
soluble in alcohol, ether, and benzene

## Additional Data:

coefficient of expansion,  
0.00101 at 10 to 30° C.

## dilution ratios:

with toluene . . . . . 6.0with petroleum naphtha . . . . 1.2

## ISOPROPYL METHACRYLATE

## Synonyms:

methacrylic acid isopropyl ester

Formula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{COOCH}(\text{CH}_3)_2$ 

Formula Weight: 128.2

Boiling Point: 127° C. (at 760 mm.)

Specific Gravity: 0.890(20/4)

Refractive Index: 1.412 at 24° C.

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

## ISOPROPYL METHYL ETHER

## Synonyms:

2-methoxypropane  
methyl isopropyl etherFormula:  $\text{CH}_3\text{OCH}(\text{CH}_3)_2$ 

Formula Weight: 74.1

Boiling Point: 32.5° C. (at 777 mm.)

Specific Gravity: 0.7347(20/20)

## Solubility:

slightly soluble in water  
very soluble in alcohol  
very soluble in ether

## 3-ISOPROPYL-5-METHYL-1-HEXANOL

## Synonyms:

diamyl alcohol            isocapric alcohol  
 $\beta$ -isoamyl-isoamyl alcohol

## Formula:

 $(\text{CH}_3)_2\text{CHCH}(\text{CH}_2\text{OH})(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$ 

Characteristics: oily

Formula Weight: 158.3

## Boiling Point:

211° C. (at 760 mm.)

203.3° C. (at 764 mm.)

Specific Gravity: 0.8569(0/4)

## Solubility:

insoluble in water    soluble in alcohol

## ISOPROPYL NITRATE

Synonyms: 2-propanol nitrate

Formula:  $(\text{CH}_3)_2\text{CHONO}_2$ 

Formula Weight: 105.1

Boiling Point: 102° C. (at 760 mm.)

Specific Gravity: 1.036(20/4)

## ISOPROPYL NITRITE

Synonyms: 2-propanol nitrite

Formula:  $(\text{CH}_3)_2\text{CHONO}$ 

Formula Weight: 89.1

Boiling Point: 45° C. (at 760 mm.)

Specific Gravity: 0.844(25/4)

### ISOPROPYL OXALATE

Synonyms:

diisopropyl oxalate

oxalic acid diisopropyl ester

oxalic acid isopropyl ester

Formula:  $[\text{COOCH}(\text{CH}_3)_2]_2$

Formula Weight: 174.2

Boiling Point:

190° C. (at 760 mm.)

193.5° C. (at 760 mm.)

### o-ISOPROPYLPHENOL

Synonyms: o-cumenol

Formula:  $(\text{CH}_3)_2\text{CHC}_6\text{H}_4\text{OH}$

Formula Weight: 136.2

Melting Point: 15 to 16° C.

Boiling Point:

214 to 215° C. (at 760 mm.)

204° C. (at 760 mm.)

Specific Gravity:

1.012 at 20° C.      1.028 at 18° C.

Solubility:

slightly soluble in water

very soluble in alcohol

very soluble in ether

### ISOPROPYL PHENYL ETHER

Synonyms:

isopropoxybenzene      2-phenoxypropane

Formula:  $(\text{CH}_3)_2\text{CHOC}_6\text{H}_5$

Formula Weight: 136.2

Boiling Point: 177.2° C. (at 760 mm.)

Specific Gravity: 0.9464(15/15)

### ISOPROPYL PROPIONATE

Synonyms: propionic acid isopropyl ester

Formula:  $\text{CH}_3\text{CH}_2\text{COOCH}(\text{CH}_3)_2$

Characteristics:

agreeable odor      plum flavor

bitter-sweet taste

Formula Weight: 116.2

Boiling Point:

109 to 111° C. (at 750 mm.)

111 to 113° C. (at 760 mm.)

111 to 112° C. (at 760 mm.)

Specific Gravity: 0.881 to 0.893 at 0° C.

Uses:

synthetic apricot and peach flavors

Solubility (grams per 100 ml.):

0.6 (in water) at 25° C.

$\infty$  (in alcohol)       $\infty$  (in ether)

### ISOPROPYL PROPYL ETHER

Synonyms: 2-propoxypropane

Formula:  $(\text{CH}_3)_2\text{CHOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 102.2

Boiling Point: 82 to 83° C. (at 760 mm.)

Solubility:

insoluble in water       $\infty$  (in ether)

soluble in alcohol

### 2-ISOPROPYLPYRIDINE

Formula:  $(\text{CH}_3)_2\text{CHC}_5\text{H}_4\text{N}$

Formula Weight: 121.2

Boiling Point: 158 to 159° C. (at 760 mm.)

Specific Gravity: 0.934 at 0° C.

Solubility:

slightly soluble in water

$\infty$  (in alcohol)       $\infty$  (in ether)

### 4-ISOPROPYLPYRIDINE

Formula:  $(\text{CH}_3)_2\text{CHC}_5\text{H}_4\text{N}$

Formula Weight: 121.2

Boiling Point: 177 to 178° C. (at 760 mm.)

Specific Gravity: 0.944 at 0° C.

Solubility:

slightly soluble in water

soluble in alcohol       $\infty$  (in ether)

## ISOPROPYL SALICYLATE

Synonyms: salicylic acid isopropyl ester

Formula:  $\text{HOC}_6\text{H}_4\text{COOCH}(\text{CH}_3)_2$

Formula Weight: 180.2

Boiling Point: 120 to 122° C. (at 18 mm.)

Specific Gravity: 1.010 at 25° C.

## ISOPROPYL SUCCINATE

Synonyms:

diisopropyl succinate

succinic acid diisopropyl ester

succinic acid isopropyl ester

Formula:  $[\text{CH}_2\text{COOCH}(\text{CH}_3)_2]_2$

Formula Weight: 202.2

Boiling Point: 247.1° C. (at 760 mm.)

Specific Gravity: 1.019(0/0)

## ISOPROPYL SULFIDE

Synonyms:

diisopropyl sulfide

2-(isopropylthio)propane

Formula:  $(\text{CH}_3)_2\text{CHSCH}(\text{CH}_3)_2$

Formula Weight: 118.2

Boiling Point:

120.4° C. (at 760 mm.)

120.5° C. (at 763 mm.)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

ISOPROPYL d-TARTRATE

Synonyms:

d-tartaric acid isopropyl ester

d-tartaric acid diisopropyl ester

Formula:  $[\text{CHOHCOOCH}(\text{CH}_3)_2]_2$

Formula Weight: 234.2

Boiling Point: 275° C. (at 760 mm.)

Specific Gravity: 1.130 at 20° C.

## ISOPROPYL THIOCYANATE

Synonyms:

isopropyl rhodanate

isopropyl sulfocyanate

thiocyanic acid isopropyl ester

Formula:  $(\text{CH}_3)_2\text{CHSCN}$

Formula Weight: 101.2

Boiling Point:

149 to 151° C. (at 760 mm.)

152 to 153° C. (at 760 mm.)

Specific Gravity: 0.963 at 20° C.

Solubility:

insoluble in water      ∞ (in alcohol)  
∞ (in ether)

## ISOPROPYL VINYL ETHER

Formula:  $\text{CH}_2\text{:CHOCH}(\text{CH}_3)_2$

Characteristics:

pale yellow to light brown

Formula Weight: 86.2

Boiling Point: 55.00° C. (at 760 mm.)

Specific Gravity:

0.754(20/20)      6.28 lbs. per gal.

Refractive Index: 1.3845 at 20° C.

Uses:

organic syntheses  
manufacture of polymers

Additional Data:

the commercial product contains  
stabilizers which can be removed by  
simple distillation  
the ether may form peroxides

## ISOPULEGOL

Synonyms: 8(9)-p-menthen-3-ol

Formula:  $\text{C}_{10}\text{H}_{17}\text{OH}$

Characteristics:

mint-like odor      peach flavor  
very bitter, marked burning taste

Formula Weight: 154.2

Boiling Point: 86 to 89° C. (at 10 mm.)

Specific Gravity: 0.911(20/4)

Uses:

perfumes  
synthetic apricot, caramel, cherry,  
peach, and plum flavors

Solubility:

very slightly soluble in water

### ISOQUINOLINE

Synonyms:

benzazine                      leucoline

Formula:  $C_6H_4CH:NCH:CH$

Formula Weight: 129.2

Melting Point: 23.0 to 14.6°C.

Boiling Point:

240.5°C. (at 763 mm.)

243°C. (at 760 mm.)

Specific Gravity:

1.0986(20/4)                      9.15 lbs. per gal.

Refractive Index: 1.62233 at 25.1°C.

Uses:

dyes                      pharmaceuticals  
insecticides              rubber  
organic syntheses      accelerators

Solubility:

very slightly soluble in water  
soluble in alcohol, ether, dilute mineral  
acids, most common organic solvents  
like alcohols, ethers, ketones,  
aliphatic and aromatic hydrocarbons

### ISOVALERALDEHYDE

Synonyms:

isoamyl aldehyde  
isovalerial  
3-methylbutanal  
2-methyl-4-butanal  
valeraldehyde  
valeric aldehyde

Formula:  $(CH_3)_2CHCH_2CHO$

Characteristics: apple-like odor

Formula Weight: 86.1

Melting Point: -51°C.

Boiling Point: 92.5°C. (at 760 mm.)

Specific Gravity:

0.803(17/4)                      0.7845(20/20)

Refractive Index: 1.3902

Uses:

flavors                      perfumes

Solubility:

slightly soluble in water  
soluble in alcohol      soluble in ether

### ISOVALERIC ACID

Synonyms:

propylacetic acid  
3-methylbutanoic acid  
β-methylbutyric acid

Formula:  $(CH_3)_2CHCH_2COOH$

Characteristics:

unpleasant odor  
somewhat sour taste

Formula Weight: 102.1

Melting Point:

-37.6°C.                      -51°C.

Boiling Point: 176.7°C. (at 760 mm.)

Specific Gravity:

0.937(15/4)                      0.931(20/20)

Refractive Index: 1.40178 at 22.4°C.

Uses:

manufacture of esters for flavoring  
essences

Solubility (grams per 100 ml.):

4.2 (in water) at 20°C.  
∞ (in alcohol)              ∞ (in ether)  
very soluble in chloroform

### ISOVALERONITRILE

Synonyms:

isobutyl cyanide  
3-methylbutanenitrile

Formula:  $(CH_3)_2CHCH_2CN$

Formula Weight: 83.1

## ISOVALERONITRILE (Cont.)

## Boiling Point:

126 to 128° C. (at 714 mm.)

129.3° C. (at 760 mm.)

## Specific Gravity:

0.807(20/20)

0.802

## Solubility:

slightly soluble in water

∞ (in alcohol) ∞ (in ether)

## ISOVALEROPHENONE

## Synonyms:

isobutyl phenyl ketone

3-methyl-1-phenyl-1-butanone

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COC}_6\text{H}_5$ 

Formula Weight: 162.2

## Boiling Point:

227 to 228° C. (at 710 mm.)

225° C. (at 760 mm.)

## Specific Gravity:

0.993 at 17.8° C.

0.967

Refractive Index: 1.51385 at 15.3° C.

## Solubility:

insoluble in water ∞ (in alcohol)

∞ (in ether)

## ISOVALERYL CHLORIDE

## Synonyms:

isovaleric acid chloride

3-methylbutanoyl chloride

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COCl}$ 

Formula Weight: 120.6

## Boiling Point:

113° C. (at 760 mm.)

114 to 115° C. (at 726 mm.)

## Specific Gravity:

0.989(20/4)

0.9854(24/4)

Refractive Index: 1.41361 at 24.3° C.

## Solubility:

decomposes in water

decomposes in alcohol

soluble in ether

## K

## KAIROLINE

## Synonyms:

N-methyl-tetrahydroquinoline

1,2,3,4-tetrahydro-1-methylquinoline

1-methyl-1,2,3,4-tetrahydroquinoline

Formula:  $\text{C}_9\text{H}_{10}\text{NCH}_3$ 

Formula Weight: 147.2

## Boiling Point:

245.5° C. (at 760 mm.)

248 to 250° C. (at 758 mm.)

## Specific Gravity:

1.022(20/4)

1.021

Refractive Index: 1.4802 at 23.1° C.

## Solubility:

very soluble in alcohol

slightly soluble in ether

## KEROSENE

## Synonyms:

astral oil

No. 1 Fuel Oil

coal oil

Boiling Point: 180 to 300° C. (at 760 mm.)Specific Gravity: <1, ca. 0.80Flash Point: 100 to 165° F. (closed)

Uses:  
solvent enamels  
fuel paints  
alkyd resins thinners  
asphalt coatings varnishes

Additional Data:  
autoignition temperature approx.,  
490° F.

KETINE

Synonyms:  
2, 5-dimethylpyrazine  
glycoline

Formula: N:C(CH<sub>3</sub>)CH:NC(CH<sub>3</sub>):CH  
Formula Weight: 108.1  
Melting Point: 15° C.  
Boiling Point: 155° C. (at 760 mm.)  
Specific Gravity: 0.990(18/4)  
Refractive Index: 1.49921 at 23.6° C.  
Solubility:  
∞ (in water) ∞ (in ether)  
∞ (in alcohol)

L

dl-LACTIC ACID

Synonyms:  
ordinary or fermentation lactic acid  
2-hydroxypropionic acid  
*α*-hydroxypropionic acid  
ethylidenelactic acid

Formula: CH<sub>3</sub>CHOHCOOH

Characteristics:  
hygroscopic  
syropy  
sour taste  
practically odorless

Formula Weight: 90.1  
Melting Point:  
16.8° C. 18° C.  
Boiling Point: 122° C. (at 15 mm.)  
Specific Gravity:  
1.249(15/4) 1.206  
Refractive Index: 1.4414

Uses:  
emulsifier for cheese and confectionery  
acidulent for nonalcoholic beverages  
solvent for cellulose formate  
organic syntheses antiseptics

essences analytical reagent  
extracts pickles  
syrops

Solubility:  
∞ (in water) ∞ (in alcohol)  
∞ (in ether)  
very soluble in glycerine

Additional Data:  
decomposes on boiling  
the commercial product contains lactic  
acid and lactic anhydride equivalent  
to 85 to 95% lactic acid

LACTONITRILE

Synonyms:  
acetaldehyde cyanohydrin  
aldehyde cyanohydrin  
ethylidene cyanohydrin  
*α*-hydroxypropionitrile  
2-hydroxypropanenitrile  
lactic acid nitrile

Formula: CH<sub>3</sub>CH(OH)CN  
Characteristics: straw colored  
Formula Weight: 71.1  
Melting Point: -40° C.

## LACTONITRILE (Cont.)

## Boiling Point:

182 to 184° C. (at 760 mm.)  
slight decomposition  
102° C. (at 30 mm.)

## Specific Gravity:

0.992(18/4)                      0.9877(20/4)

## Refractive Index: 1.4058 at 18.4° C.

## Uses: organic syntheses

## Solubility:

very soluble in water  
very soluble in alcohol  
soluble in ether  
decomposes in alkali  
insoluble in carbon disulfide  
insoluble in petroleum ether

## Additional Data:

corrodes iron and lead readily and  
copper slightly  
tin, aluminum, brass and rubber stand  
up against 95% lactronitrile at room  
temperature

## LACTONITRILE ACETATE

## Synonyms:

*d*-acetoxypionitrile  
*d*-cyanoethyl acetate

Formula:  $\text{CH}_3\text{CH}(\text{OOCCH}_3)\text{CN}$

Formula Weight: 113.1

## Boiling Point:

172 to 173° C. (at 760 mm.)  
60 to 62° C. (at 10 mm.)

Specific Gravity: 1.032 at 14° C.

## Solubility (grams per 100 ml.):

4.0 (in water)                      soluble in alcohol  
very soluble in ether  
very soluble in alkali  
very soluble in glacial acetic acid

## LAURONITRILE

## Synonyms:

dodecanenitrile                      n-undecyl cyanide  
lauric acid nitrile

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{COCN}$

Characteristics: oily

Formula Weight: 181.3

Melting Point: 4° C.

Boiling Point: 198° C. (at 100 mm.)

Specific Gravity: 0.8373 at 15° C.

## Solubility:

insoluble in water  
slightly soluble in alcohol  
very soluble in ether

## LAUROYL CHLORIDE

## Synonyms:

dodecanoyl chloride  
lauric acid chloride

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{COCl}$

Formula Weight: 218.8

Melting Point: -17° C.

Boiling Point: 145° C. (at 18 mm.)

## Solubility:

decomposes in water  
decomposes in alcohol  
soluble in ether

## LEPIDINE

## Synonyms:

cincholepidine  
 $\gamma$ - or 4-methylquinoline

Formula:  $\text{CH}_3\text{C}_9\text{H}_6\text{N}$

## Characteristics:

oily                                      quinone-like odor

Formula Weight: 143.2

## Melting Point:

5° C.                                      0° C.

## Boiling Point:

261 to 263° C. (at 760 mm.)  
258 to 263° C. (at 760 mm.)

Specific Gravity: 1.086(20/4)

## Uses:

organic syntheses	pharmaceuticals
dyes	rubber
insecticides	accelerator

Solubility:  
very slightly soluble in water  
∞ (in alcohol)            ∞ (in ligroin)  
∞ (in ether)  
very soluble in benzene  
soluble in dilute mineral acids and in  
most common organic solvents like  
alcohols, ethers, esters, ketones,  
aliphatic and aromatic hydrocarbons

Additional Data:  
becomes red-brown when exposed to  
light

LEVULINALDEHYDE

Synonyms:  
levulinic (acid) aldehyde  
γ-ketovaleraldehyde  
4-oxopentanal

Formula: CH<sub>3</sub>COCH<sub>2</sub>CH<sub>2</sub>CHO

Formula Weight: 100.1

Melting Point: < -21° C.

Boiling Point:  
186 to 188° C. (at 760 mm.) decomposes  
187.0° C. (at 760 mm.)

Specific Gravity: 1.018(20/4)

Refractive Index: 1.4263

Solubility:  
∞ (in water)            ∞ (in alcohol)  
very soluble in ether

LEWISITE

Synonyms:  
chlorovinylarsine dichloride  
β-chlorovinylchloroarsine  
dichloro(2-chlorovinyl)arsine

Formula: CHCl:CHAsCl<sub>2</sub>

Characteristics:  
colorless if pure  
violet to brown  
geranium-like odor

Formula Weight: 207.3

Melting Point: -18.2 to 0.1° C.

Boiling Point:  
190° C. (at 760 mm.) decomposes

Vapor Pressure (mm. Hg): 0.394 at 20° C.

Specific Gravity: 1.888(20/4)

Heat of Vaporization (gram-calories  
per g.): 57.9

Solubility:  
insoluble and decomposes in water  
soluble in alcohol, ether, and benzene  
decomposes in alkali

Additional Data:  
coefficient of expansion,  
0.00094 at 0 to 50° C.  
vapor density, 7.2  
volatility, 2300 mg./cu. m. at 20° C.

dl-LIMONENE

Synonyms:  
dl-1, 8(9)-p-menthadiene  
dipentene

Formula: C<sub>10</sub>H<sub>16</sub>

Formula Weight: 136.2

Boiling Point:  
176 to 180° C. (at 760 mm.)  
178° C. (at 760 mm.)

Specific Gravity:  
0.865 at 18° C.            0.845 at 20° C.

Refractive Index: 1.473

Solubility:  
insoluble in water  
very soluble in alcohol  
very soluble in ether

d-LIMONENE

Synonyms:  
carvene            hesperidine  
citrene  
d-1, 8(9)-p-menthadiene

Formula: C<sub>10</sub>H<sub>16</sub>

Characteristics:  
caraway, lemon or orange odor  
bitter-burning taste

Formula Weight: 136.2

## d - LIMONENE (Cont.)

Melting Point:  $-96.9^{\circ}\text{C}$ .Boiling Point:  $175$  to  $177^{\circ}\text{C}$ . (at  $760$  mm.)Specific Gravity:  $0.842(20/4)$ Refractive Index:  $1.47489$  at  $14.7^{\circ}\text{C}$ .

## Uses:

synthetic banana and grenadine flavors  
 synthetic caraway, dill and other spice  
 oils

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## Additional Data:

odor and flavor varies with source

d-LINALOOL

## Synonyms:

coriandrol

d-3, 7-dimethyl-1, 6-octadien-3-olFormula:  $\text{C}_{10}\text{H}_{18}\text{O}$ 

## Characteristics:

odor like bergamot oil or French  
 lavender

Formula Weight:  $154.3$ 

## Boiling Point:

 $198.3^{\circ}\text{C}$ . (at  $760$  mm.) $195$  to  $199^{\circ}\text{C}$ . (at  $760$  mm.)

## Specific Gravity:

 $0.8622(20/4)$   $0.873$ Refractive Index:  $1.4623$ 

## Uses:

synthetic apricot, banana, cranberry,  
 currant, orange, orris, date, malt,  
 pear, plum, quince, and raspberry  
 flavors  
 bergamot and lavender perfumes

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
 10 volumes dissolve in 100 volumes  
 of 50% alcohol

l-LINALOOL ACETATE

## Synonyms:

bergamol

licareol acetate

bergamiol

linalyl acetate

Formula:  $\text{CH}_3\text{COOC}_{10}\text{H}_{17}$ 

## Characteristics:

oily

odor like bergamot

Formula Weight:  $196.3$ 

## Boiling Point:

 $220^{\circ}\text{C}$ . (at  $760$  mm.) decomposes

## Specific Gravity:

 $0.895(20/4)$  $0.903$  to  $0.912(25/25)$ 

## Refractive Index:

 $1.4460$  $1.451$  to  $1.453$ 

## Uses:

extracts

perfumes

## Solubility:

very slightly soluble in water

 $\infty$  (in alcohol) $\infty$  (in ether)

## LINOLEIC ACID

## Synonyms:

linolic acid

9, 12-octadecadienoic acid

Formula:  $\text{C}_{17}\text{H}_{31}\text{COOH}$ 

## Characteristics:

colorless to yellow oily

Formula Weight:  $280.4$ 

## Melting Point:

 $-11^{\circ}\text{C}$ . $-18^{\circ}\text{C}$ .

## Boiling Point:

 $229$  to  $230^{\circ}\text{C}$ . (at  $16$  mm.) $208^{\circ}\text{C}$ . (at  $11$  mm.)

## Specific Gravity:

 $0.903(18/4)$  $0.9025(20/4)$ Refractive Index:  $1.4688$ 

## Solubility:

insoluble in water

 $\infty$  (in alcohol) $\infty$  (in ether)

## Additional Data:

acid number, 200.4theoretical iodine number, 181.3

## LINOLENIC ACID

Synonyms: octadecatrienoic acid

Formula:  $C_{17}H_{29}COOH$ 

Characteristics: oily

Formula Weight: 278.4

Boiling Point:

230 to 232°C. (at 17 mm.)

207°C. (at 15 mm.)

Specific Gravity:

0.914(18/4)

0.905(20/4)

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

Additional Data:

acid number, 201.8theoretical iodine number, 273.4

## 2,4-LUTIDINE

Synonyms:

2,4-dimethylpyridine

 $\alpha$ ,  $\gamma$ -lutidineFormula:  $(CH_3)_2C_5H_3N$ 

Formula Weight: 107.2

Boiling Point:

157.1°C. (at 760 mm.)

159°C. (at 760 mm.)

Specific Gravity: 0.9493(0/4)

Solubility (grams per 100 ml.):

20 (in cold water)

slightly soluble in hot water

soluble in alcohol    soluble in ether

## 2,5-LUTIDINE

Synonyms: 2,5-dimethylpyridine

Formula:  $(CH_3)_2C_5H_3N$ 

Formula Weight: 107.2

Boiling Point: 156.5°C. (at 760 mm.)

Specific Gravity: 0.938 at 0°C.

Solubility (grams per 100 ml.):

25 (in cold water)

slightly soluble in hot water

very soluble in alcohol

very soluble in ether

## 2,6-LUTIDINE

Synonyms:

2,6-dimethylpyridine

 $\alpha$ ,  $\alpha'$ -lutidineFormula:  $(CH_3)_2C_5H_3N$ 

Formula Weight: 107.2

Boiling Point: 142 to 143°C. (at 760 mm.)

Specific Gravity:

0.942(0/4)

7.27 lbs. per gal.

Uses:

dyes

resins

insecticides

rubber

pharmaceuticals

accelerators

Solubility:

 $\infty$  (in cold water)

slightly soluble in hot water

soluble in alcohol, ether, most common

organic solvents like alcohols, ethers,

esters, ketones, aliphatic and aro-

matic hydrocarbons

## 3,4-LUTIDINE

Synonyms:

3,4-dimethylpyridine

 $\beta$ ,  $\gamma$ -lutidineFormula:  $(CH_3)_2C_5H_3N$ 

Formula Weight: 107.2

Boiling Point:

163.5 to 164.5°C. (at 760 mm.)

Solubility:

soluble in alcohol

soluble in ether

## M

dl-MANDELONITRILE

## Synonyms:

dl-benzaldehyde cyanohydrin  
mandelic (acid) nitrile

Formula:  $C_6H_5CH(OH)CN$

## Characteristics:

yellow oily

Formula Weight: 133.1

Melting Point:  $-10^{\circ}C$ .

Boiling Point: decomposes at  $170^{\circ}C$ .

Specific Gravity: 1.124

## Solubility:

insoluble in water  
soluble in alcohol, ether, and  
chloroform

p-MENTHANE

## Synonyms:

hexahydro-p-cymene  
4-isopropyl-1-methylcyclohexane  
menthonaphthene  
terpene

Formula:  $CH_3C_6H_{10}CH(CH_3)_2$

Formula Weight: 140.3

## Boiling Point:

169 to  $170^{\circ}C$ . (at 760 mm.)  
164 to  $167^{\circ}C$ . (at 760 mm.)  
 $169.5^{\circ}C$ . (at 760 mm.)

Specific Gravity: 0.793(20/0)

Refractive Index: 1.437

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

d-MENTHENE

## Synonyms:

d-4-isopropyl-1-methyl-3-cyclohexene  
d-3-p-menthene

Formula:  $C_{10}H_{18}$

Characteristics: oily

Formula Weight: 138.3

## Boiling Point:

$167^{\circ}C$ . (at 760 mm.)  
 $168$  to  $169^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

0.814(16/4) 0.8073

Refractive Index: 1.44813 at  $20.4^{\circ}C$ .

## Solubility:

soluble in alcohol, ether, and benzene

l-MENTHONE

Synonyms: l-3-p-menthanone

Formula:  $C_{10}H_{18}O$

## Characteristics:

mobile liquid  
slight peppermint odor and flavor  
oily bitter-sweet taste

Formula Weight: 154.3

Melting Point:  $-6.6^{\circ}C$ .

Boiling Point:  $207^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

0.897 at  $15^{\circ}C$ . 0.892 to  
0.896(20/20) 0.895(25/25)

## Refractive Index:

1.4505 1.448 to 1.453

Uses: peppermint flavors

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
 $\infty$  (in carbon disulfide plus benzene)  
one volume dissolves in 3 volumes of  
70% alcohol

## Additional Data:

optical rotation,  $[\alpha]$  -24.80

1-MENTHYL ACETATE

## Synonyms:

acetic acid menthyl ester  
menthol acetic ester  
menthol acetic ether

Formula:  $\text{CH}_3\text{COOC}_{10}\text{H}_{19}$

## Characteristics:

peppermint, menthol-like odor  
bitter-sweet taste  
peppermint-caraway flavor

Formula Weight: 198.3

## Boiling Point:

227.0 to 228° C. (at 760 mm.)  
227 to 228° C. (at 760 mm.)

## Specific Gravity:

0.925 at 20° C.      0.922 to  
0.919(20/4)      0.927(25/25)

## Refractive Index:

1.4469 to 1.44680 at 25° C.  
1.444 to 1.449

## Uses:

perfumes  
synthetic caraway and peppermint  
type essences

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)  
one volume dissolves in 15 volumes  
of 65% and in 6 volumes of 70%  
alcohol

## Additional Data:

optical rotation [ $\alpha$ ] -72°47' to -73°18'

1-MENTHYLAMINE

Synonyms: aminomenthane

Formula:  $\text{C}_{10}\text{H}_{19}\text{NH}_2$

Characteristics: oily

Formula Weight: 155.3

Boiling Point: 209° C. (at 760 mm.)

Specific Gravity: 0.861(20/4)

## Solubility:

soluble in cold water  
very soluble in alcohol

## MENTHYL ISOVALERATE

## Synonyms:

isovaleric acid menthyl ester  
valido

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COOC}_{10}\text{H}_{19}$

Formula Weight: 240.4

Boiling Point: 129° C. (at 9 mm.)

## Specific Gravity:

0.907(15/4)  
0.895 to 0.898(25/25)

Refractive Index: 1.446 to 1.448

## Solubility:

insoluble in water  
soluble in alcohol, ether, and  
chloroform

## MENTHYL SALICYLATE

## Synonyms:

salimenthol      samol

Formula:  $\text{HOC}_6\text{H}_4\text{COOC}_{10}\text{H}_{19}$

Characteristics: oily

Formula Weight: 276.4

Boiling Point: 203 to 205° C. (at 20 mm.)

Specific Gravity: 1.045(25/25)

Uses: unofficial medicine

## Solubility:

insoluble in water  
soluble in alcohol, ether, chloroform,  
and fatty oils

## MERCAPTOACETIC ACID

## Synonyms:

2-mercaptoethanoic acid  
thioglycolic acid

Formula:  $\text{HSCH}_2\text{COOH}$

Formula Weight: 92.1

Melting Point: -16.5° C.

## Boiling Point:

104 to 106° C. (at 11 mm.)  
123° C. (at 29 mm.)

## MERCAPTOACETIC ACID (Cont.)

Specific Gravity: 1.3253(20/4)

Solubility:

soluble in water, alcohol, and ether

## 2-MERCAPTOETHANOL

Synonyms:

ethanol-1-thiol-2

hydroxyethylmercaptan

monothioglycol

thioethylene glycol

thiomonoglycol

Formula:  $\text{HOCH}_2\text{CH}_2\text{SH}$ 

Characteristics:

odor like  $\text{H}_2\text{S}$  and alcohol

mobile liquid

Formula Weight: 78.1

Freezing Point:  $-100^\circ\text{C}$ .

Boiling Point:

 $53^\circ\text{C}$ . (at 10 mm.)

 $157.1^\circ\text{C}$ . (at 760 mm.)

 $55$  to  $56^\circ\text{C}$ . (at 9 mm.)

Vapor Pressure (mm. Hg):  $1.0$  at  $20^\circ\text{C}$ .

Specific Gravity:

 $1.1168(20/20)$ 
 $9.3$  lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:  $1.5011$  at  $20^\circ\text{C}$ .

Viscosity (centipoises):  $3.43$  at  $20^\circ\text{C}$ .

Flash Point:  $165^\circ\text{F}$ . (open)

Uses:

organic syntheses of dyes, intermediates, flotation agents, rubber chemicals, insecticides, plasticizers, pickling inhibitors, pharmaceuticals, and synthetic resins

Solubility:

 $\infty$  (of water)  $\infty$  (in water)

very soluble in alcohol, ether, and benzene

completely miscible with most organic solvents

 $\alpha$ -MERCAPTOPROPIONIC ACID

Synonyms: thiolactic acid

Formula:  $\text{CH}_3\text{CH}(\text{SH})\text{COOH}$ 

Characteristics: oily

Formula: 106.1

Melting Point:  $10^\circ\text{C}.$ 

Boiling Point:  $98$  to  $99^\circ\text{C}$ . (at 14 mm.)

Solubility:

 $\infty$  (in water)  $\infty$  (in ether)

 $\infty$  (in alcohol)

 $\beta$ -MERCAPTOPROPIONIC ACID

Synonyms: thiohydracrylic acid

Formula:  $\text{HSCH}_2\text{CH}_2\text{COOH}$ 

Formula Weight: 106.1

Melting Point:  $16.8^\circ\text{C}$ .

Boiling Point:

 $111$  to  $112^\circ\text{C}$ . (at 15 mm.)

 $113.5$  to  $115.5^\circ\text{C}$ . (at 13 to 14 mm.)

Specific Gravity:  $1.218$  at  $21^\circ\text{C}$ .

Solubility:

 $\infty$  (in water)  $\infty$  (in ether)

 $\infty$  (in alcohol)

## MESCALINE

Synonyms:

3,4,5-trimethoxyphenethylamine

mezcaline

Formula:  $\text{C}_{11}\text{H}_{17}\text{NO}_3$ 

Characteristics:

alkaline oily

Formula Weight: 211.3

Boiling Point:  $180^\circ\text{C}$ . (at 12 mm.)

Solubility:

soluble in water, alcohol, chloroform, and benzene

insoluble in ether

## MESIDINE

Synonyms: 2, 4, 6-trimethylaniline

Formula:  $(\text{CH}_3)_3\text{C}_6\text{H}_2\text{NH}_2$

Formula Weight: 135.2

Melting Point:  $< -15^\circ\text{C}$ .

Boiling Point:  $229$  to  $233^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 0.963

## MESITYLENE

Synonyms:

sym- or 1, 3, 5-thimethylbenzene

Formula:  $(\text{CH}_3)_3\text{C}_6\text{H}_3$

Formula Weight: 120.2

Melting Point:

$-44.8^\circ\text{C}$ .  $-52.7^\circ\text{C}$ .

Boiling Point:  $164.6^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 0.8634(20/4)

Refractive Index: 1.4967

Solubility:

insoluble in water    soluble in alcohol  
very soluble in ether  
 $\infty$  (in benzene)

## MESITYL OXIDE

Synonyms:

isopropylideneacetone  
methyl isobutenyl ketone  
4-methyl-3-penten-2-one

Formula:  $(\text{CH}_3)_2\text{C}:\text{CHCOCH}_3$

Characteristics:

strong peppermint-like odor  
oily

Formula Weight: 98.1

Melting Point:  $-59^\circ\text{C}$ .

Freezing Point:  $-46.6^\circ\text{C}$ .

Boiling Point:

$128.7^\circ\text{C}$ . (at  $760$  mm.)  
 $129$  to  $130^\circ\text{C}$ . (at  $750$  mm.)  
 $131.4^\circ\text{C}$ . (at  $760$  mm.)  
 $120$  to  $135^\circ\text{C}$ . (at  $760$  mm.)  
 $128.0^\circ\text{C}$ . (at  $760$  mm.)  
 $117$  to  $139^\circ\text{C}$ . (at  $760$  mm.)

Vapor Pressure (mm. Hg): 8.7 at  $20^\circ\text{C}$ .

Specific Gravity:

0.8569(20/20)                      0.8539(20/4)  
0.855 at  $20^\circ\text{C}$ .                  0.8546(20/4)  
7.12 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:

1.446 at  $16^\circ\text{C}$ .                      1.4439 at  $20^\circ\text{C}$ .  
1.4456 at  $20^\circ\text{C}$ .                      1.4442

Viscosity (centipoises): 0.60 at  $20^\circ\text{C}$ .

Flash Point:

$90^\circ\text{F}$ .,  $98^\circ\text{F}$ . (open)  
 $79$  to  $87^\circ\text{C}$ . (closed)

Specific Heat (gram-calories per g.  
per  $^\circ\text{C}$ .): 0.521 (liquid) at  $21$  to  $121^\circ\text{C}$ .

Heat of Vaporization (gram-calories  
per g.): 85.8

Uses:

solvent for ethyl cellulose, nitrocel-  
lulose and low-viscosity cellulose  
acetate, polyvinyl chloride, high  
molecular weight vinyl copolymer  
resin, stains, lacquers, roll coating  
inks, surface coatings  
ore flotation  
paint and varnish removers  
organic syntheses    insect repellent

Solubility :

3.4 (of water) % by weight at  $20^\circ\text{C}$ .  
3.0 (in water) % by weight at  $20^\circ\text{C}$ .  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## MESITYL OXIDE (Cont.)

## Additional Data:

vapor density, 3.40

azeotrope with water boils at 91.8° C.

and contains 65.2% of mesityl oxide  
by weight

coefficient of expansion,

0.000599 per ° F.

0.00108 at 10 to 30° C.

dilution ratios:

with toluene. . . . . 3.8with petroleum naphtha . . . . 0.9dissolves alkyd resins, Amberol,  
beeswax, castor oil, coumarone,  
ester gum, kauri gum, linseed oil,  
mineral oil, nitrocellulose, pine oil,  
rosin, tung oil, vinyl resins, un-  
vulcanized rubberpartly dissolves carnauba, cellulose  
acetate, dammar, manila, paraffin,  
pontianak, and shellac

## METHACRYLALDEHYDE

## Synonyms:

methacrolein            2-methylpropenal

*α*-methylacroleinFormula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{CHO}$ 

Formula Weight: 70.1

Boiling Point:

68.4° C. (at 760 mm.)

73.5° C. (at 760 mm.)

Specific Gravity:

0.830(20/4)            0.837(20/4)

Refractive Index: 1.4191 at 20° C.

Solubility (grams per 100 ml.):

6.4 (in water)            ∞ (in ether)

∞ (in alcohol)

## METHACRYLIC ACID

## Synonyms:

*α*-methacrylic acid

2-methylpropenoic acid

Formula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{COOH}$ 

Formula Weight: 86.1

Melting Point: 15 to 16° C.

Boiling Point: 161 to 163° C. (at 760 mm.)

Specific Gravity: 1.015(20/4)

Refractive Index: 1.43143

Solubility:

soluble in hot water

∞ (in alcohol)            ∞ (in ether)

## METHACRYLIC ANHYDRIDE

Formula:  $[\text{CH}_2:\text{C}(\text{CH}_3)\text{CO}]_2\text{O}$ 

Formula Weight: 154.2

Boiling Point:

98° C. (at 25 mm.)    84° C. (at 11 mm.)

Specific Gravity: 1.0243

Refractive Index: 1.4525 at 25° C.

Solubility:

decomposes in water

∞ (in alcohol)            ∞ (in ether)

## METHACRYLONITRILE

## Synonyms:

*α*-methylacrylonitrile*2*-methylpropenenitrileFormula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{CN}$ 

Formula Weight: 67.1

Melting Point: -40° C.

Boiling Point:

90.0 to 90.3° C. (at 760 mm.)

Specific Gravity: 0.805

Refractive Index: 1.4002

Solubility:

∞ (in alcohol)            ∞ (in ether)

## METHALLYL ETHER

Synonyms: *β*-dimethallyl etherFormula:  $[\text{CH}_2:\text{C}(\text{CH}_3)\text{CH}_2]_2\text{O}$ 

Formula Weight: 126.2

Boiling Point: 134° C. (at 760 mm.)

Specific Gravity: 0.816(20/4)

Solubility (grams per 100 ml.):  
<0.1 (in water)

### METHANESULFONIC ACID

Synonyms: methylsulfonic acid

Formula:  $\text{CH}_3\text{SO}_3\text{H}$

Formula Weight: 96.1

Boiling Point:  
167° C. (at 10 mm.) decomposes

Specific Gravity: 1.481(18/4)

Solubility:  
very soluble in water  
very soluble in ether  
soluble in alcohol

### METHANESULFONYL CHLORIDE

Synonyms:  
methylsulfone chloride  
methyl sulfonic chloride

Formula:  $\text{CH}_3\text{SO}_2\text{Cl}$

Formula Weight: 114.6

Boiling Point:  
161.5° C. (at 730 mm.)  
160° C. (at 760 mm.)

Specific Gravity:  
1.481(18/4)                      1.51

Solubility:  
insoluble in cold water  
decomposes in hot water  
soluble in alcohol      soluble in ether

### METHANETHIOL

Synonyms:  
methanthiol                      methyl mercaptan

Formula:  $\text{CH}_3\text{SH}$

Formula Weight: 48.1

Melting Point:  
-123.1° C.                      -121° C.

Boiling Point:  
6.8° C. (at 760 mm.)  
7.6° C. (at 760 mm.)  
5.8° C. (at 752 mm.)

Specific Gravity:  
0.868(20/4)                      0.8599(25/4)

Solubility:  
slightly soluble in water, decomposes  
very soluble in alcohol  
very soluble in ether

Additional Data:  
critical temperature, 196.8° C.  
critical pressure, 71.9 atm.

### METHANOL

Synonyms:  
acetone alcohol                      methyl hydrate  
carbinol                              methyl hydroxide  
colonial spirits                      methylic alcohol  
columbian spirits                      pyroligneous spirit  
columnian spirits                      pyroxylic spirit  
green wood spirits                      wood alcohol  
Manhattan spirits                      wood naphtha  
methyl alcohol                      wood spirit  
standard wood spirits

Formula:  $\text{CH}_3\text{OH}$

Characteristics: poison

Formula Weight: 32.0

Melting Point: -97.8° C.

Boiling Point:  
64.65° C. (at 760 mm.)  
64 to 66° C. (at 760 mm.)

Specific Gravity:  
0.7960 at 15° C.                      0.7924(20/20)  
0.7928(20/4)  
6.6 lbs. per gal. at 20° C.

Refractive Index:  
1.33118 at 14.5° C.      1.329 at 20° C.

Surface Tension (dynes per cm.): 22.6

Absolute Viscosity (millipoises):  
5.93 at 20° C.

Inflammability Range (volume per cent  
in air):  
6.7 (lower limit)                      36 (upper limit)

Flash Point:  
60° F. (open)  
54 to 57° F. (closed)

## METHANOL (Cont.)

Specific Heat (gram-calories per g. per °C.):

0.566 at 0° C., 0.600 at 20° C.

0.645 at 25 to 43° C. (liquid)

Heat of Vaporization (gram-calories per g.): 262.8 at 64.5° C.

Heat of Fusion (gram-calories per g.): 16.4

Heat of Combustion (gram-calories per g.): 5334 (liquid)

## Uses:

solvent for cellulose nitrate, dyes, fats, gums, oils, resins, shellac, and waxes

## Solubility:

∞ (of water) ∞ (in alcohol)

∞ (in water) ∞ (in ether)

## Additional Data:

coefficient of expansion,

0.000661 per °F. 0.00117 per °C.

critical pressure, 78.7 atm.

critical temperature, 240° C.

dielectric constant, 31.2 at 20° C.

electrical conductivity,

$4.4 \times 10^{-7}$  mhos

weight of pure vapor, 1430 mg./ℓ.

vapor density, 1.11

dilution ratios:

with toluene . . . . . 2.5

with petroleum naphtha . . . . 0.3

autoignition temperature, 878° F.

Specific Gravity: 1.1768(20/4)

## Solubility:

very soluble in water, alcohol, and ether

p-METHOXY-tert-AMYL BENZENE

Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{C}_5\text{H}_{11}$

Formula Weight: 178.3

Boiling Point: 113 to 114° C. (at 13 mm.)

## 3-METHOXYBUTYL ACETATE

Synonyms: Butoxyl

Formula:  $\text{CH}_3\text{OCH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{OOCCH}_3$

Formula Weight: 146.1

Boiling Point: 135 to 173° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 3 at 30° C.

## Specific Gravity:

0.956 at 20° C.

8.37 lbs. per gal. at 20° C.

Flash Point: 170° F. (closed)

Solubility (grams per 100 ml.):

3.72 (of water) 6.46 (in water)

## Additional Data:

coefficient of expansion,

0.00100 at 10 to 30° C.

dilution ratios:

with xylene . . . . . 2.1

with mineral spirits . . . . . 0.9

## METHOXYACETIC ACID

## Synonyms:

glycolic methyl ether

methoxyethanoic acid

methylglycolic acid

Formula:  $\text{CH}_3\text{OCH}_2\text{COOH}$

Characteristics: hygroscopic

Formula Weight: 90.1

## Boiling Point:

89 to 91° C. (at 7 mm.)

203 to 204° C. (at 760 mm.)

## METHOXYETHYL/ CHLOROFORMATE

## Synonyms:

β-methoxyethyl chlorocarbonate

Formula:  $\text{ClCOOCH}_2\text{CH}_2\text{OCH}_3$

Formula Weight: 138.6

Boiling Point: 54 to 60° C. (at 13 mm.)

## METHOXYETHYL FORMATE

Formula:  $\text{HCOOCH}_2\text{CH}_2\text{OCH}_3$

Formula Weight: 104.1

Boiling Point:

131 to 131.5° C. (at 760 mm.)

Specific Gravity: 1.048(15/4)

#### METHOXYETHYL METHYLAL

Formula:  $(\text{CH}_3\text{OCH}_2)_2\text{O}$

Formula Weight: 106.1

Boiling Point: 106 to 108° C. (at 760 mm.)

Specific Gravity: 0.959(20/20)

#### METHOXYETHYL METHYL SALICYLATE

Synonyms:

mesotan

salmester

Formula:  $\text{HOC}_6\text{H}_4\text{COOCH}_2\text{OCH}_3$

Characteristics: oily

Formula Weight: 182.2

Boiling Point: 162° C. (at 42 mm.)

Specific Gravity: 1.2 at 15° C.

Solubility:

very slightly soluble in water

∞ (in alcohol)

∞ (in chloroform)

∞ (in ether)

∞ (in benzene)

#### m-METHOXYPHENOL

Synonyms: resorcinol methyl ether

Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{OH}$

Formula Weight: 124.1

Melting Point: < -17.5° C.

Boiling Point:

243.3 to 244.4° C. (at 760 mm.)

Specific Gravity: >1

Solubility:

slightly soluble in water

∞ (in alcohol)

soluble in alkalis

∞ (in ether)

#### p, γ-METHOXPYRIDINE

Formula:  $\text{CH}_3\text{OC}_5\text{H}_4\text{N}$

Formula Weight: 109.1

Boiling Point: 190 to 191° C. (at 738 mm.)

Solubility: ∞ (in water)

#### p-METHOXYQUINOLINE

Synonyms: quinanisole

Formula:  $\text{CH}_3\text{OC}_9\text{H}_6\text{N}$

Formula Weight: 159.2

Melting Point: 26 to 28° C.

Boiling Point: 254° C. (at 310 mm.)

Specific Gravity: 1.154 at 20° C.

Solubility: soluble in alcohol

#### 2-METHOXYSTYRENE

Synonyms:

o-methoxystyrene

o-vinylanisole

Formula:  $\text{CH}_2\text{:CHC}_6\text{H}_4\text{OCH}_3$

Characteristics: aromatic odor

Formula Weight: 134.2

Boiling Point:

195 to 200° C. (at 760 mm.)

83 to 84° C. (at 12 mm.)

Specific Gravity: 1.0095(15/4)

Refractive Index: 1.556

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

#### 3-METHOXYSTYRENE

Synonyms:

m-methoxystyrene

m-vinylanisole

Formula:  $\text{CH}_2\text{:CHC}_6\text{H}_4\text{OCH}_3$

Characteristics: oily

Formula Weight: 134.2

Boiling Point: 89 to 90° C. (at 14 mm.)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## METHYL ABIETATE

**Synonyms:** Abalyn

Formula:  $C_{19}H_{29}COOCH_3$

### Characteristics:

pale yellow                  viscous  
very faint, mild, ether-like odor

Formula Weight: 316.5

### Boiling Point:

360 to 365° C. (at 760 mm.) decomposes

### Specific Gravity:

1.020 to 1.030 at 20° C.

1.040(20/20)      8.53 lbs. per gal.

Refractive Index:

1.5295 to 1.5300 at 20°C.

Viscosity (poises): 28 to 34 at 25° C.

## Flash Point: 356° F. (open)

**Uses:**

non-drying inks      lacquers  
organic syntheses      plastics  
plasticizer for chlorinated rubber,  
ethyl cellulose, and nitrocellulose  
high-boiling solvent  
extender for phenolic varnish resins

**Solubility:**

insoluble in water    ∞ (in alcohol)  
                               ∞ (in ether)

miscible with all ethers, organic esters, ketones, alcohols, coal tar and petroleum hydrocarbons, vegetable and mineral oils

### Additional Data:

does not freeze at  $-40^{\circ}\text{C}$ .

extremely viscous at low temperatures  
acid number, 6 or less

saponification number, 20 to 25  
 color (Lovibond 50 mm. tube),  
 10 to 15 amber

flame point (open cup), 424.4° F.

thiocyanogen value, 75 to 80

specific rotation, +13

dielectric constant,

3.63 at 25° C.      3.23 at 100° C.

power factor,

0.2% at 250° C.      43.5% at 1000° C.  
(60 cycles A.C.)

dielectric strength,  
29 KV - (0.01" gap at 100° C.)

METHYL ACETATE

Synonyms:  
acetic acid methyl ester  
methyl acetic ester  
methyl acetic ether

Formula:  $\text{CH}_3\text{COOCH}_3$

Characteristics:  
pleasant ethereal fragrant odor  
mobile liquid                      inflammable  
bitter, burning taste  
aroma of wild pear

Formula Weight: 74.1

Melting Point:  
-98.1° C.                                      -98.7° C.

Boiling Point:  
59 to 60° C. (at 760 mm.)  
57.1° C. (at 760 mm.)  
53 to 58° C. (at 760 mm.)  
54.05° C. (at 760 mm.)

Specific Gravity:  
0.92740(25/4)                      0.908 at 20° C.  
0.924(20/4)  
0.904 to 0.914 at 20° C.  
7.6 lbs. per gal. at 20° C.

Refractive Index:  
1.35935                                      1.3619 at 20° C.

Inflammability Range (volume per cent in air):  
3.1, 4.1 (lower limit)  
15.5, 13.9 (upper limit)

Flash Point:  
200° F. (open)                      150° F. (closed)

Specific Heat (gram-calories per g. per °C.): 0.468 (liquid)

Uses:  
solvent for acetylcellulose, artificial leather, cellulose esters and dopes, cosmetics, flavoring extracts, lacquers, leather dyes, nitro-cellulose, plastics, perfumes, Vinyl and Vinylite resins, and varnishes  
extractant for fats and oils  
purification of penicillin  
removal of surgical adhesive tape  
synthetic raspberry essences  
synthetic arrack, rum, and whisky  
flavors for alcoholic beverages  
thinners                                      synthetic leather

Solubility (grams per 100 ml.):  
31.9 (in water) at 20° C.  
33 (in water) at 22° C.  
 $\infty$  (in alcohol)                       $\infty$  (in ether)  
miscible with common hydrocarbon solvents

Additional Data:  
weight of pure vapor, 3300 mg./ℓ.  
vapor density, 2.6  
autoignition temperature, 935° F.  
coefficient of expansion,  
0.00134 at 10 to 30° C.  
dilution ratios:  
with toluene. . . . . 2.9  
with petroleum naphtha . . . . 0.9  
critical temperature, 233.7° C.  
critical pressure, 46.3 atm.

METHYL ACETOACETATE

Synonyms:  
acetoacetic acid methyl ester

Formula:  $\text{CH}_3\text{COCH}_2\text{COOCH}_3$

Formula Weight: 116.1

Melting Point: -80° C.

Boiling Point:  
169 to 170° C. (at 760 mm.)  
slight decomposition  
171.7° C. (at 760 mm.)  
88 to 93° C. (at 50 mm.)  
84° C. (at 40 mm.)

Vapor Pressure (mm. Hg): 0.7 at 20° C.

Specific Gravity:  
1.077(20/4)                      1.0785(20/20)  
9.0 lbs. per gal. at 20° C.

Refractive Index: 1.41837 at 20.5° C.

Flash Point: 180° F. (closed)

Uses:  
organic syntheses  
chemical intermediate  
solvent for cellulose ethers, component of solvent mixtures for cellulose esters

## METHYL ACETOACETATE (Cont.)

Solubility (grams per 100 ml.):

19.8 (of water) at 20° C.38.0 (in water)44.5 (in water) at 20° C. $\infty$  (in alcohol)  $\infty$  (in ether)Additional Data: vapor density, 4.00

## METHYLACETONE

Synonyms:

synthetic liquid containing various  
amounts of acetone, methyl acetate,  
and methanol, such as  
acetone 47.5-51%,  
methyl acetate 27.5-31%, and  
methanol 20.0-25%

Boiling Point:

50 to 67° C. (at 760 mm.)54 to 70° C. (at 760 mm.)

Specific Gravity:

0.8300 to 0.8360(20/20)6.92 lbs. per gal. at 20° C.6.07 lbs. per gal. at 60° F.

Flash Point: 23° F. (open)

Uses:

dewaxing natural gums  
extracting perfumes  
artificial leather      extracts  
cements                      gas mantles  
paint, lacquer, and varnish removers  
plastics  
solvent for cellulose acetate, gums,  
lacquers, nitrocellulose, resins,  
and rubber  
coagulating agent for latex  
used in the manufacture of rubber  
products

Solubility:

$\infty$  (of water)  $\infty$  (in water)  
miscible with oils and hydrocarbons

Additional Data:

coefficient of expansion,  
0.00138 per ° C. at 10 to 30° C.

dilution ratios:

with toluene. . . . . 4.7with petroleum naphtha . . . . 0.7

## p-METHYLACETOPHENONE

Synonyms: methyl p-tolyl ketone

Formula:  $\text{CH}_3\text{COC}_6\text{H}_4\text{CH}_3$ 

Characteristics:

sweet taste                      pale yellow  
fragrant odor like clover-honey and  
coumarin  
strawberry flavor

Formula Weight: 134.2

Melting Point: 28° C.

Boiling Point:

222° C. (at 760 mm.)228° C. (at 760 mm.)

Specific Gravity:

0.9891(22/4) 1.001 to1.013(13/4) 1.004(25/25)

Refractive Index:

1.53533 at 17.4° C. 1.533 to 1.535

Uses:

perfumes  
synthetic raspberry and strawberry  
flavors

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether  
one part dissolves:  
in 14 volumes of 45% alcohol,  
in 10 volumes of 50% alcohol,  
in 5 volumes of 60% alcohol, and  
in 2 volumes of 70% alcohol

## METHYL ACRYLATE

Synonyms: acrylic acid methyl ester

Formula:  $\text{CH}_2\text{:CHCOOCH}_3$ 

Formula Weight: 86.1

Freezing Point: > -78° C.

Boiling Point:

80.2° C. (at 760 mm.)80.5° C. (at 760 mm.)79 to 80° C. (at 760 mm.)

Specific Gravity:

0.949 at 25° C. 0.953(20/4)0.974 at 0° C. 7.95 lbs. per gal.

## Refractive Index:

1.400 at 25°C. 1.3984

Flash Point: 270°F. (open)

Uses: organic syntheses

## Solubility:

very slightly soluble in water  
soluble in alcohol soluble in ether

## Additional Data:

the commercial product contains an  
inhibitor  
polymerizes easily

## METHYL ADIPATE (mono)

## Synonyms:

adipic acid monomethyl ester  
methyl hydrogen adipateFormula:  $\text{CH}_3\text{OOC}(\text{CH}_2)_2\text{COOH}$ 

Formula Weight: 160.2

Melting Point: 8 to 9°C.

Boiling Point: 162°C. (at 10 mm.)

## METHYLAL

## Synonyms:

dimethoxymethane formal  
formaldehydedimethylacetal  
methylene dimethylate  
methylene dimethyl etherFormula:  $\text{CH}_2(\text{OCH}_3)_2$ 

## Characteristics:

alcohol-chloroform-like odor  
inflammable pungent taste

Formula Weight: 76.1

Melting Point: -104.8°C.

## Boiling Point:

42.3°C. (at 760 mm.)  
42 to 44°C. (at 760 mm.)  
41.5 to 43.5°C. (at 760 mm.)

## Specific Gravity:

0.8660 to 0.8662 0.8601(20/4)  
0.8630(20/4) 0.8560  
0.888(18/4)

## Refractive Index:

1.35344 1.3530 to 1.3550

Flash Point: 0°C. (open)

## Uses:

superior solvent to ether in many  
respects for organic acids and other  
organic compounds because of its  
relatively high water solubility,  
ability to be salted out of solution  
quickly, and stability towards alkalis  
solvent for acetylene, antimony  
chloride, cadmium nitrate, cellulose  
nitrate, copper chloride, ethyl-  
cellulose, ferric chloride, mercuric  
chloride, mercuric iodide, methyl  
methacrylate, stannous chloride, and  
polystyrene  
vaporizing solvent for various types of  
coating processes  
good methylating agent  
gives improved water resistance to  
polyvinyl alcohol and cellulose  
derivatives for use in textiles and  
paper products

## Solubility (grams per 100 ml.):

33 (in water) at 20°C.  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
hydrolyzes in mineral acids forming  
formaldehyde and methyl alcohol  
stable in alkalis

## Additional Data:

azeotrope with water contains 98.6%  
of methylal and boils at 42.05°C.  
azeotrope with methyl alcohol contains  
92.15% of methylal and boils at  
41.82°C.  
is a mild anesthetic without irritant  
properties

## N-METHYLALLYLAMINE

Formula:  $\text{CH}_2\text{CHCH}_2\text{NHCH}_3$ 

Formula Weight: 71.1

Boiling Point: 64 to 66°C. (at 760 mm.)

Solubility: very soluble in water

## 2-METHYLAMINOETHANOL

Synonyms:  $\beta$ -methylaminoethanolFormula:  $\text{CH}_3\text{NHCH}_2\text{CH}_2\text{OH}$ 

Characteristics: oily

Formula Weight: 75.1

Boiling Point:  $159^\circ\text{C.}$  (at 747 mm.)Specific Gravity: 0.937 at  $20^\circ\text{C.}$ 

Solubility:

$\infty$ (in water)	$\infty$ (in alcohol)
	$\infty$ (in ether)

N-METHYLANILINE

Synonyms: methylphenylamine

Formula:  $\text{C}_6\text{H}_5\text{NHCH}_3$ 

Characteristics:

oily

yellow to reddish brown

Formula Weight: 107.2

Melting Point:

 $-80^\circ\text{C.}$  $-57^\circ\text{C.}$ 

Boiling Point:

 $190$  to  $191^\circ\text{C.}$  (at 760 mm.) $195.7^\circ\text{C.}$  (at 760 mm.)

Specific Gravity:

0.991

0.986(20/4)

Refractive Index: 1.57021 at  $21.2^\circ\text{C.}$ 

Uses: organic syntheses

Solubility (grams per 100 ml.):

0.01 (in water) at  $25^\circ\text{C.}$ 

very slightly soluble in water

soluble in alcohol

 $\infty$  (in ether)

soluble in chloroform

## METHYL ANTHRANILATE

Synonyms:

artificial neroli oil

anthranilic acid methyl ester

methyl 2-aminobenzoate

methyl o-aminobenzoateFormula:  $\text{NH}_2\text{C}_6\text{H}_4\text{COOCH}_3$ 

Characteristics:

bitter, burning taste  
odor of orange flower  
orange flavor

Formula Weight: 151.2

Melting Point:

 $8.2^\circ\text{C.}$  $24^\circ\text{C.}$ 

Boiling Point:

 $135.5^\circ\text{C.}$  (at 15 mm.) $255^\circ\text{C.}$  (at 760 mm.)

Specific Gravity: 1.168(18.8/4)

Uses:

synthetic banana, currant, melon,  
quince, lemon, orange, pineapple,  
woodruff flavors, and grape essence  
perfumes

Solubility:

slightly soluble in water

soluble in ether      soluble in alcohol

one volume dissolves:

in 20 volumes of 45% alcohol and

in 5 volumes of 90% alcohol

## METHYL BENZOATE

Synonyms:

benzoic acid methyl ester

oil of niobe

Formula:  $\text{C}_6\text{H}_5\text{COOCH}_3$ 

Characteristics:

harsh bitter taste      oily

strong, harsh fragrant odor of oil of  
wintergreen

strawberry flavor

Formula Weight: 136.1

Melting Point:  $-12.5^\circ\text{C.}$ 

Boiling Point:

 $198$  to  $199.6^\circ\text{C.}$  (at 760 mm.)

Specific Gravity:

1.0937(15/4)

1.0930(15.5/15.5)

1.088(20/4)

Refractive Index: 1.51810 at  $16^\circ\text{C.}$ Flash Point:  $181.4^\circ\text{F.}$  (open)

## Uses:

solvent for cellulose esters and ethers,  
resins, and rubber  
medicines                      perfumes  
rubber preservative  
soaps  
artificial raspberry, pineapple, and  
strawberry flavors

## Solubility (grams per 100 ml.):

0.0157 (in water) at 30° C.

∞ (in alcohol)                      ∞ (in ether)

## Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
45	1:1000
60	1:4
70	1:1

Additional Data: fire point, 185° F.

## 2-METHYLBENZOPHENONE

## Synonyms:

o-methyl benzophenone  
phenyl o-tolyl ketone

Formula:  $C_6H_5COC_6H_4CH_3$

Formula Weight: 196.2

Melting Point: <-18° C.

Boiling Point: 312 to 315° C. (at 735 mm.)

## Solubility:

insoluble in water  
very soluble in 80% alcohol  
very soluble in ether

## 3-METHYLBENZOPHENONE

## Synonyms:

m-methyl benzophenone  
phenyl m-tolyl ketone

Formula:  $C_6H_5COC_6H_4CH_3$

Formula Weight: 196.2

Boiling Point: 321° C. (at 761 mm.)

Specific Gravity: 1.088 at 17.5° C.

## Solubility:

∞ (in alcohol)                      ∞ (in chloroform)  
∞ (in ether)

## METHYL BENZOYLACETATE

## Synonyms:

benzoylacetic acid methyl ester

Formula:  $C_6H_4COCH_2COOCH_3$

Characteristics: colorless to yellow

Formula Weight: 178.2

## Boiling Point:

152° C. (at 15 mm.)

265° C. (at 760 mm.) decomposes

## Specific Gravity:

1.173(0/4)

1.158(20/4)

Refractive Index: 1.53654 at 24.7° C.

## Solubility:

insoluble in water                      ∞ (in alcohol)  
∞ (in ether)

*d*-METHYLBENZYL ALCOHOL

## Synonyms:

sec-styrollyl or styralyl alcohol  
methylphenylcarbinol  
1-phenylethanol  
sec- or *d*-phenylethyl alcohol

Formula:  $C_6H_5CHOHCH_3$

## Characteristics:

faint agreeable odor  
sweet taste  
faint peach flavor

Formula Weight: 122.2

Melting Point: 20° C.

## Boiling Point:

204 to 205° C. (at 760 mm.)

203.6° C. (at 745 mm.)

105 to 107° C. (at 12 mm.)

## Specific Gravity:

1.013(20/4)

1.008 to

1.000(25/4)

1.013(25/25)

1.019(13/4)

Refractive Index: 1.526 to 1.529

## Uses:

synthetic apricot and peach essences

*a*-METHYLBENZYL ALCOHOL (Cont.)

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

one volume dissolves:

in 18 volumes of 30% alcohol,  
in 10 volumes of 40% alcohol,  
in 3 volumes of 50% alcohol

*a*-METHYLBENZYLAMINE

Synonyms: *a*-phenylethylamine

Formula:  $C_6H_5CH(NH_2)CH_3$

Formula Weight: 121.2

Boiling Point: 187.5° C. (at 741 mm.)

Specific Gravity: 0.940 at 15° C.

Solubility (grams per 100 ml.):

4.2 (in water) at 20° C.

$\infty$  (in alcohol)             $\infty$  (in ether)

N-METHYLBENZYLANILINE

Formula:  $C_6H_5CH_2N(CH_3)C_6H_5$

Formula Weight: 197.3

Melting Point: 9.2° C.

Boiling Point: 305 to 306° C. (at 760 mm.)

Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

2-METHYLBIPHENYL

Synonyms: o-phenyltoluene

Formula:  $C_6H_5C_6H_4CH_3$

Formula Weight: 168.2

Boiling Point: 260 to 264° C. (at 760 mm.)

Specific Gravity: 1.010(20/4)

Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

3-METHYLBIPHENYL

Synonyms: m-phenyltoluene

Formula:  $C_6H_5C_6H_4CH_3$

Formula Weight: 168.2

Boiling Point: 272 to 277° C. (at 760 mm.)

Specific Gravity: 1.031(0/4)

Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

4-METHYLBIPHENYL

Synonyms: p-phenyltoluene

Formula:  $C_6H_5C_6H_4CH_3$

Formula Weight: 168.2

Melting Point: -3° C.

Boiling Point: 267° C. (at 760 mm.)

Specific Gravity: 1.015 at 27° C.

Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

METHYL BROMOACETATE

Synonyms: bromoacetic acid methyl ester

Formula:  $CH_2BrCOOCH_3$

Formula Weight: 153.0

Boiling Point: 51 to 52° C. (at 15 mm.)

METHYL o-BROMOBENZOATE

Synonyms:

o-bromobenzoic acid methyl ester

Formula:  $BrC_6H_4COOCH_3$

Formula Weight: 215.1

Boiling Point: 244 to 246° C. (at 760 mm.)

METHYL *a*-BROMOLAURATE

Synonyms:

*a*-bromolauric acid methyl ester

Formula:  $C_{10}H_{21}CHBrCOOCH_3$

Formula Weight: 293.3

Boiling Point: 145 to 146° C. (at 8 mm.)

**3-METHYL-1,2-BUTADIENE**

Synonyms: unsym-dimethylallene

Formula:  $\text{CH}_2:\text{C}:\text{C}(\text{CH}_3)_2$

Formula Weight: 68.1

Melting Point:  $-120^\circ\text{C}$ .

Boiling Point:

40.5 to  $41.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.683(20/4)

Refractive Index: 1.410 at  $20^\circ\text{C}$ .

Specific Heat (Btu. per lb. per  $^\circ\text{F}$ .):

0.538 (liquid) at  $77.5^\circ\text{F}$ .

Heat of Vaporization (Btu. per lb.):

163.4 at the boiling point

Additional Data:

specific gravity of gas

(ideal, air = 1.0), 2.3515

specific gravity of liquid (in vacuo),

0.680(20/4) $^\circ\text{C}$ . 0.685(60/60) $^\circ\text{F}$ .

API gravity (at  $60^\circ\text{F}$ .), 75.1

coefficient of expansion,

0.00085 at 60 to  $77^\circ\text{F}$ .

total heating values,

20,060 Btu./lb.,

113,100 Btu./cu. ft.-gas at  $77^\circ\text{F}$ .

**2-METHYLBUTANE**

Synonyms:

ethylmethylethane

isopentane

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$

Characteristics:

mobile liquid

pleasant odor

inflammable

Formula Weight: 72.2

Melting Point:

$-160.5^\circ\text{C}$ .

$-159.7^\circ\text{C}$ .

Boiling Point:

27 to  $31^\circ\text{C}$ . (at 760 mm.)

$27.95^\circ\text{C}$ . (at 760 mm.)

$29.8^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.621 at  $19^\circ\text{C}$ .

Refractive Index:

1.355

1.35373

Inflammability Range: 1.3 (lower limit)

Flash Point:  $-70.5^\circ\text{F}$ . (open)

Specific Heat (Btu. per lb. per  $^\circ\text{F}$ .):

0.562 (liquid) at  $62.4^\circ\text{F}$ .

Heat of Vaporization (Btu. per lb.):

145.66 at the boiling point

146.56 at  $77^\circ\text{F}$ .

Uses:

anesthetic, artificial ice

fluid for low temperature

thermometers

lubricant for Claude liquid ice

machines

Solubility:

insoluble in water  $\infty$  (in alcohol)

soluble in oils  $\infty$  (in ether)

soluble in hydrocarbons

Additional Data:

specific gravity of gas

(ideal, air = 1.0), 2.4907

API gravity (at  $60^\circ\text{F}$ .), 95.0

specific gravity of liquid (in vacuo),

0.61967(20/4) $^\circ\text{C}$ . 0.62476(60/60) $^\circ\text{F}$ .

aniline point,  $169.3^\circ\text{F}$ .

coefficient of expansion,

0.00085 at 32 to  $68^\circ\text{F}$ .

total heating values,

20,877 Btu./lb.,

107,080 Btu./cu. ft.-gas at  $77^\circ\text{F}$ .

critical temperature,  $187.8^\circ\text{C}$ .

critical pressure, 32.8 atm.

**3-METHYL-1,2-BUTANEDIOL**

Synonyms:

$\alpha$ -isoamylene glycol

isopropylethylene glycol

Formula:  $(\text{CH}_3)_2\text{CHCHOHCH}_2\text{OH}$

Formula Weight: 104.2

Boiling Point:  $206^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.9987(0/4)

Solubility:

soluble in alcohol soluble in ether

## 3-METHYL-1,3-BUTANEDIOL

Synonyms:  $\gamma$ -isoamylene glycolFormula:  $(\text{CH}_3)_2\text{COHCH}_2\text{CH}_2\text{OH}$ 

Characteristics:

viscous                      syrupy

Formula Weight: 104.2

Boiling Point: 202 to 203°C. (at 760 mm.)

Specific Gravity: 0.9892(20/4)

Solubility:

soluble in water              soluble in alcohol

## 2-METHYL-2,3-BUTANEDIOL

Synonyms:

 $\alpha$ -isoamylene glycol  
trimethylethylene glycolFormula:  $(\text{CH}_3)_2\text{COHCHOHCH}_3$ 

Characteristics:

viscous                      oily

Formula Weight: 104.2

Boiling Point: 177°C. (at 760 mm.)

Specific Gravity: 0.9893(0/0)

Solubility:

 $\infty$  (in water)                       $\infty$  (in ether)  
 $\infty$  (in alcohol)

## 2-METHYL-1-BUTANETHIOL

Synonyms: pri-act-amyl mercaptanFormula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{SH}$ 

Formula Weight: 104.2

Boiling Point: 119 to 121°C. (at 760 mm.)

Specific Gravity: 0.8415(23/4)

## 3-METHYL-1-BUTANETHIOL

Synonyms:

isoamyl mercaptan  
2-methyl-4-butanethiolFormula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_3)_2\text{SH}$ 

Formula Weight: 104.2

Boiling Point:

129.5°C. (at 760 mm.)

119°C. (at 760 mm.)

Specific Gravity: 0.835(20/4)

Refractive Index: 1.44118

Solubility:

insoluble in water               $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 2-METHYL-1-BUTANOL

Synonyms:

d-pri-act-amyl alcohol  
d-sec-butylcarbinol  
2-methylbutan-1-ol  
2-methylbutanol-1Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$ 

Formula Weight: 88.2

Melting Point: < -70°C.

Boiling Point:

128°C. (at 760 mm.)

125 to 131°C. (at 760 mm.)

Specific Gravity:

0.81 to 0.82(20/20)    0.816(20/4)  
6.80 lbs. per gal.Refractive Index: 1.41 at 20°C.

Viscosity (centipoises):

5.09 at 20°C.

1.44 at 60°C.Flash Point: 122°F. (open)Heat of Vaporization (gram-calories  
per g.): 100

Uses:

organic syntheses    solvent

Solubility (grams per 100 ml.):

3.6 (in water) at 30°C.

 $\infty$  (in alcohol)                       $\infty$  (in ether)soluble in methyl alcohol, acetone,  
benzene, gasoline, and ethyl acetate

Additional Data:

coefficient of expansion,  
0.00078 per °C.the synthetic product is a racemic  
mixture

## 3-METHYL-2-BUTANOL

## Synonyms:

sec-isoamyl alcohol  
methyl isopropyl carbinol

Formula:  $(\text{CH}_3)_2\text{CHCHOHCH}_3$

Formula Weight: 88.2

Boiling Point: 112 to 114° C. (at 760 mm.)

Specific Gravity: 0.819(20/4)

Flash Point: 103° F. (closed)

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

Additional Data: vapor density, 3.04

## 3-METHYL-2-BUTANONE

## Synonyms:

isopropyl methyl ketone  
2-methyl-3-butanone  
methyl isopropyl ketone

Formula:  $\text{CH}_3\text{COCH}(\text{CH}_3)_2$

Formula Weight: 86.1

Melting Point: -92° C.

## Boiling Point:

88.9° C. (at 760 mm.)  
93 to 95° C. (at 760 mm.)

## Specific Gravity:

0.803(20/0) 0.815(15/4)

Refractive Index: 1.38788 at 16° C.

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## 3-METHYL-2-BUTANONE OXIME

## Synonyms: methyl isopropyl ketoxime

Formula:  $\text{CH}_3\text{C:NOHCH}(\text{CH}_3)_2$

Formula Weight: 101.2

Boiling Point: 157 to 158° C. (at 760 mm.)

## Solubility:

soluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 2-METHYL-1-BUTENE

Synonyms: uns-ethylmethylethylene

Formula:  $\text{CH}_2\text{:C}(\text{CH}_3)\text{CH}_2\text{CH}_3$

Formula Weight: 70.1

Boiling Point: 31.0° C. (at 760 mm.)

Refractive Index: 1.3778 at 20° C.

## Additional Data:

specific gravity of gas  
(ideal, air = 1.0), 2.4211  
specific gravity of liquid (in vacuo),  
0.6504(20/4)° C. 0.6577(60/60)° F.  
API gravity (at 60° F.), 84.3  
liquid density (in vacuo) at 60° F., 5.467  
coefficient of expansion,  
0.00090 at 60 to 77° F.  
total heating values (at 77° F.),  
20,390 Btu./lb.  
109,800 Btu. cu. ft.-gas

## 3-METHYL-1-BUTENE

## Synonyms:

$\alpha$ -isoamylene isopropylethylene

Formula:  $(\text{CH}_3)_2\text{CHCH:CH}_2$

Formula Weight: 70.1

Melting Point: -135° C.

## Boiling Point:

20.2° C. (at 760 mm.)  
21 to 25° C. (at 760 mm.)

## Specific Gravity:

0.648(20/4)  
5.285 lbs. per gal. at 60° F.

Refractive Index: 1.3590 at 20° C.

Uses: organic syntheses

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## Additional Data:

critical temperature, 377° F.  
critical pressure, 498 psia.

## 2-METHYL-2-BUTENE

## Synonyms:

$\beta$ -isoamylene            trimethylethylene  
3-methyl-2-butene

Formula:  $(\text{CH}_3)_2\text{C}:\text{CHCH}_3$ 

Formula Weight: 70.1

## Melting Point:

-133° C.                      -124° C.

Boiling Point: 37 to 38.5° C. (at 760 mm.)

## Specific Gravity:

0.663(19/4)                      0.668(13/4)

Refractive Index: 1.3874 at 20° C.

Specific Heat (Btu. per lb. per ° F.):  
0.508 (liquid) at 60° F.

Heat of Vaporization (Btu. per lb.):  
167.5 at the boiling point

Uses: organic syntheses

## Solubility:

very slightly soluble in water  
soluble in alcohol     $\infty$  (in ether)  
very soluble in 2 parts sulfuric acid  
and 1 part water

## Additional Data:

specific gravity of gas  
(ideal, air = 1.0), 2.4211  
specific gravity of liquid (in vacuo),  
0.6623(20/4)° C.    0.6676(60/60)° F.  
API gravity (at 60° F.), 80.5  
liquid density (in vacuo) at 60° F., 5.566  
aniline point, 51.8° F.  
critical temperature, 377° F.  
critical pressure, 519 psia.  
coefficient of expansion,  
0.00088 at 60 to 77° F.  
total heating values (at 77° F.),  
20,410 Btu./lb.,  
111,900 Btu./cu. ft.-gas

 $\beta$ -METHYLBUTYL ACETATE

## Synonyms:

acetic acid  $\beta$ -methylbutyl ester  
amyl acetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}(\text{CH}_3)\text{C}_2\text{H}_5$ 

Formula Weight: 130.2

Boiling Point: 141 to 142° C. (at 760 mm.)

Specific Gravity: 0.880 at 12.5° C.

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

N-METHYLBUTYLAMINEFormula:  $\text{CH}_3\text{NHC}_4\text{H}_9$ 

Formula Weight: 87.2

Boiling Point: 91 to 92° C. (at 760 mm.)

## Specific Gravity:

0.736(18/4)                      0.737(20/4)

Refractive Index: 1.40180 at 18.1° C.

*d*-METHYLBUTYLAMINE

## Synonyms:

2-aminopentane            sec-n-amylamine  
methylpropylcarbinylamine

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{CH}_3)\text{NH}_2$ 

Formula Weight: 87.2

Boiling Point: 91 to 92° C. (at 760 mm.)

## Specific Gravity:

0.749(20/4)                      0.73839(20/0)

## Solubility:

$\infty$  (in water)                       $\infty$  (in ether)  
 $\infty$  (in alcohol)

## 3-METHYL-1-BUTYNE

Synonyms: isopropylacetylene

Formula:  $(\text{CH}_3)_2\text{CHC}:\text{CH}$ 

Formula Weight: 68.1

## Boiling Point:

29.3° C. (at 760 mm.)  
28 to 29° C. (at 751 mm.)

Specific Gravity: 0.6854(0/4)

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
 $\infty$  (in ether)

**$\alpha$ -METHYLBUTYRALDEHYDE****Synonyms:**

2-methyl-1-butanal  
methyl ethyl acetaldehyde

**Formula:**  $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{CHO}$

**Formula Weight:** 86.1

**Boiling Point:**  $90.2^\circ\text{C}$ . (at 760 mm.)

**Specific Gravity:** 0.807 at  $20^\circ\text{C}$ .

**Solubility:** insoluble in water

**METHYL BUTYRATE****Synonyms:**

butyric acid methyl ester  
methyl n-butyrate

**Formula:**  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_3$

**Characteristics:**

pleasant fruity odor resembling apples  
sweet taste apple flavor

**Formula Weight:** 102.1

**Melting Point:**  $< -95^\circ\text{C}$ .

**Boiling Point:**  $102.3^\circ\text{C}$ . (at 760 mm.)

**Specific Gravity:**

0.892(20/4) 0.898 at  $20^\circ\text{C}$ .

**Refractive Index:** 1.3879

**Flash Point:**  $57^\circ\text{F}$ . (closed)

**Uses:**

synthetic apple, melon, nut, pumpkin,  
quince, raspberry, and pineapple  
flavors  
solvent for ethylcellulose  
solvent mixture for nitrocellulose and  
celluloid

**Solubility (grams per 100 ml.):**

1.56 (in water) at  $21^\circ\text{C}$ .  
 $\infty$  (in alcohol)  $\infty$  (in ether)

**Additional Data:**

vapor density, 3.52  
critical temperature,  $281.2^\circ\text{C}$ .  
critical pressure, 34.2 atm.

 **$\alpha$ -METHYLBUTYRIC ACID****Synonyms:**

active valeric acid  
2-methylbutanoic acid  
ethylmethylacetic acid  
methylethylacetic acid

**Formula:**  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{COOH}$

**Formula Weight:** 102.1

**Melting Point:**  $-80^\circ\text{C}$ .

**Boiling Point:**  $174$  to  $177^\circ\text{C}$ . (at 760 mm.)

**Specific Gravity:**

0.938(20/20) 0.941(20/4)

**Refractive Index:** 1.4051

**Solubility:**

slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

**2-METHYLBUTYRONITRILE**

**Formula:**  $\text{CH}_3\text{CH}(\text{CN})\text{CH}_2\text{CN}$

**Formula Weight:** 94.1

**Melting Point:**  $12^\circ\text{C}$ .

**Boiling Point:**  $252$  to  $254^\circ\text{C}$ . (at 760 mm.)

 **$\alpha$ -METHYLBUTYRONITRILE****Synonyms:**

sec-butyl cyanide  
2-methylbutanenitrile  
methylethylacetoneitrile

**Formula:**  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CN}$

**Formula Weight:** 83.1

**Boiling Point:**  $125^\circ\text{C}$ . (at 760 mm.)

**Specific Gravity:** 0.8061(0/4)

**Solubility:**

soluble in alcohol soluble in ether

**METHYL CAPRATE****Synonyms:**

capric acid methyl ester  
methyl decanoate

**Formula:**  $\text{CH}_3(\text{CH}_2)_8\text{COOCH}_3$

## METHYL CAPRATE

### METHYL CAPRATE (Cont.)

Formula Weight: 186.3

Melting Point:  $-18^{\circ}\text{C.}$

Boiling Point: 223 to  $224^{\circ}\text{C.}$  (at 760 mm.)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

### METHYL CAPROATE

Synonyms:

caproic acid methyl ester  
methyl hexanoate

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{COOCH}_3$

Formula Weight: 130.2

Boiling Point:  $149.5^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity: 0.9038(0/4)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

### $\alpha$ -METHYLCAPROIC ACID

Synonyms: 2-methylhexanoic acid

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{CH}_3)\text{COOH}$

Formula Weight: 130.2

Boiling Point:  $209.6^{\circ}\text{C.}$  (at 760 mm.)

Solubility:

$\infty$  (in water)       $\infty$  (in ether)  
 $\infty$  (in alcohol)

### $\delta$ -METHYLCAPROIC ACID

Synonyms:

isoamylacetic acid    isohexylyllic acid  
5-methylhexanoic acid

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{COOH}$

Formula Weight: 130.2

Melting Point:  $< -25^{\circ}\text{C.}$

Boiling Point:

211.5 to  $216.5^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity:

0.916(25/4)      0.9138(21/4)

Solubility:

slightly soluble in water  
soluble in alcohol    soluble in ether

### METHYL CAPRYLATE

Synonyms:

caprylic acid methyl ester  
methyl octanoate

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{COOCH}_3$

Formula Weight: 158.2

Melting Point:

$-4^{\circ}\text{C.}$        $-41^{\circ}\text{C.}$

Boiling Point:

192 to  $194^{\circ}\text{C.}$  (at 760 mm.)

$192.9^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity: 0.887(20/4)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

### METHYL "CARBITOL"

Synonyms:

diethylene glycol monomethyl ether  
2-(3-methoxyethoxy) ethanol

Formula:  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$

Characteristics:

hygroscopic      pleasant odor

Formula Weight: 120.2

Boiling Point:

$194.2^{\circ}\text{C.}$  (at 760 mm.)

$193.2^{\circ}\text{C.}$  (at 760 mm.)

190 to  $194^{\circ}\text{C.}$  (at 760 mm.)

Vapor Pressure (mm. Hg):

0.2 at  $20^{\circ}\text{C.}$        $< 1$  at  $30^{\circ}\text{C.}$

Specific Gravity:

1.0215(20/20)      1.035 at  $20^{\circ}\text{C.}$

1.0354(20/20)

8.6 lbs. per gal. at  $20^{\circ}\text{C.}$

Refractive Index:

1.4264 at  $27^{\circ}\text{C.}$       1.4244 at  $20^{\circ}\text{C.}$

Surface Tension (dynes per cm.):

41.3 at 25°C.

Viscosity (poises): 0.0605 at 25°C.

Flash Point: 200°F. (open)

Specific Heat (gram-calories per g. per °C.): 0.514 (liquid) at 25°C.

Heat of Vaporization (gram-calories per g.): 90.70 at the boiling point

Uses:

organic syntheses lacquers  
solvent-mixtures, wood stains  
solvent for cellulose acetate, dyes,  
fats, nitrocellulose, oils, resins,  
and waxes

Solubility:

∞ (of water) ∞ (in water)  
miscible with most organic solvents

Additional Data:

coefficient of expansion,  
0.00087 at 10 to 30°C.

dilution ratios:

with xylene, 1.0  
with mineral spirits, immiscible,  
with toluene, 2.3

final concentration 1/2 sec. RS nitro-  
cellulose, 8%

vapor density, 4.14

## METHYL "CARBITOL" ACETATE

Synonyms:

diethylene glycol monoethyl ether  
acetate

Formula:

$\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_3$

Formula Weight: 162.2

Boiling Point:

209.1°C. (at 760 mm.)  
203 to 212°C. (at 760 mm.)

Vapor Pressure (mm. Hg):

0.12 at 20°C. <1 at 30°C.

Specific Gravity:

1.040(20/20) 1.0396(20/20)  
8.7 lbs. per gal. at 20°C.

Uses:

high boiling solvent for cellulose ester  
lacquers  
printing inks

Solubility:

∞ (of water) ∞ (in water)

## METHYL CARBONATE

Synonyms:

dimethyl carbonate  
carbonic acid dimethyl ester  
carbonic acid methyl ester

Formula:  $\text{CO}(\text{OCH}_3)_2$

Characteristics: agreeable odor

Formula Weight: 90.1

Melting Point:

0.5°C. 4.5°C.

Boiling Point:

89 to 91°C. (at 760 mm.)  
89.0°C. (at 760 mm.)  
85 to 90°C. (at 760 mm.)

Vapor Pressure (mm. Hg):

47 at 20°C. 260 at 60°C.  
118 at 40°C.

Specific Gravity:

1.0694(20/4)  
8.9 lbs. per gal. at 20°C.

Refractive Index:

1.3687 1.3689 at 20°C.

Surface Tension (dynes per cm.):

28.0 at 20°C.

Viscosity (centipoises):

0.62 at 20°C.  
10% 1/2 sec. nitrocellulose solution  
at 25°C., 135

Flash Point: 66°F. (open)

Uses:

organic syntheses of a variety of  
compounds

## METHYL CARBONATE (Cont.)

## Solubility:

5.3% by weight (of water)  
 15% by weight (in water)  
 very soluble in alcohol  
 very soluble in ether  
 miscible with acids and alkalies  
 soluble in most organic solvents,  
 acetone, amyl alcohol, butyl alcohol,  
 methyl alcohol, benzene, carbon  
 disulfide, carbon tetrachloride,  
 chloroform, ethyl acetone, and  
 cyclohexane

## Additional Data:

fire point, open cup, 71° F.  
 dilution ratios (nitrocellulose solution  
 method with 100% methyl carbonate),  
 with toluene, 0.35,  
 petroleum naphtha, 0.20,  
 n-butyl alcohol, 1.90  
 dilution ratios (with 50% methyl car-  
 bonate and 50% methyl alcohol by  
 volume),  
 with toluene, 2.40,  
 petroleum naphtha, 0.60  
 stability to hydrolysis in 4 volumes of  
 water at 85° C., decomposed during  
 24 hours, 16%  
 evaporation rate at 77° F. and 50%  
 relative humidity,  
 (n-butyl acetate = 100), 280

Blush Resistance at 90° F.

	Clear	Blush
Relative humidity	<u>80%</u>	<u>85%</u>

Solubility of Various Resins  
 in Methyl Carbonate at 25° C.

Soluble to the Extent of at Least 10%

Alkyd Resin

Benzyl Cellulose

Cellulose Acetate

Cellulose Acetate-Butyrate

Cellulose Acetate-Propionate

Chlorinated Diphenyl Resin

Ethyl Cellulose

Nitrocellulose

Polymethyl Methacrylate

Polystyrene

Polyvinyl Acetal

Polyvinyl Acetate

## Insoluble

Cellulose Triacetate

Methyl Cellulose

Polyisobutylene

Polyvinyl Acetate-Chloride

Polyvinyl Butyral

Polyvinyl Chloride

Polyvinyl Formal

Terpene Resin

## METHYL "CELLOSOLVE"

## Synonyms:

ethylene glycol monomethyl ether

2-methoxyethanol

glycol monomethyl ether

Formula:  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OH}$

Characteristics: mild odor

Formula Weight: 76.1

## Boiling Point:

124 to 125° C. (at 760 mm.)

124.3° C. (at 760 mm.)

121 to 126° C. (at 760 mm.)

## Vapor Pressure (mm. Hg):

6.2 at 20° C.

## Specific Gravity:

0.965(20/4)

0.9663(20/20)

0.9660(20/4)

8.0 lbs. per gal. at 20° C.

Refractive Index: 1.4028 at 20° C.

Surface Tension (dynes per cm.):

35 at 20° C.

Viscosity (centipoises): 1.6 at 25° C.

## Flash Point:

115° F. (open)

107° F. (closed)

Specific Heat (gram-calories per g.

per ° C.): 0.534 (liquid) at 20 to 25° C.

Heat of Vaporization (gram-calories

per g.): 135 at 124.5° C.

## Uses:

solvent for alcohol-soluble dyes,  
 cellulose acetate, nitrocellulose, and  
 various resins

solvent mixtures      leather processing

enamels

perfume fixative

lacquers

varnishes

sealing moistureproof transparent

wrappers

## Solubility:

$\infty$  (of water)                       $\infty$  (in benzene)  
 $\infty$  (in water)  
 very soluble in alcohol  
 very soluble in ether  
 miscible with alcohols, glycols, and hydrocarbons

## Additional Data:

coefficient of expansion,  
     0.00094 at 10 to 30° C.  
 dilution ratios:  
     with toluene, 4.0  
     with xylene, 2.9  
     petroleum naphtha, immiscible  
     mineral spirits, immiscible  
 autoignition temperature, 551° F.  
 vapor density, 2.62

## METHYL "CELLOSOLVE" ACETAL

## Synonyms:

ethylene glycol monomethyl acetal

Formula:  $\text{CH}_3\text{CH}(\text{OCH}_2\text{CH}_2\text{OCH}_3)_2$

Formula Weight: 178.2

Boiling Point: 207.2° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.1 at 20° C.

## Specific Gravity:

0.9773(20/20)  
8.1 lbs. per gal. at 20° C.

Flash Point: 200° F. (open)

## Uses:

source of nascent acetaldehyde  
 solvent

## Solubility:

$\infty$  (of water)                       $\infty$  (in water)

## METHYL "CELLOSOLVE" ACETATE

## Synonyms:

ethylene glycol monomethyl ether  
     acetate  
 glycol monomethyl ether acetate  
 2-methoxy ethanol acetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OCH}_3$

## Characteristics:

agreeable characteristic ether odor

Formula Weight: 118.1

Melting Point: solidifies at -70° C.

## Boiling Point:

144.5° C. (at 760 mm.)  
143° C. (at 760 mm.)  
143 to 145° C. (at 760 mm.)  
137 to 147° C. (at 760 mm.)

## Specific Gravity:

1.0067(20/20)                      1.0054(20/20)  
8.37 lbs. per gal. at 20° C.

## Vapor Pressure (mm. Hg):

3.73 at 20° C.                      6 at 60° C.

Refractive Index: 1.4025 at 20° C.

## Flash Point:

140° F. (open)                      132° F. (closed)

## Uses:

dopes                                      photographic film  
 lacquers                                  textile printing  
 solvent for cellulose acetate, gums,  
     nitrocellulose, oils, resins, and  
     waxes

## Solubility:

$\infty$  (in water)                       $\infty$  (of water)  
 miscible with ordinary organic solvents

## Additional Data:

coefficient of expansion,  
     0.00110 at 10 to 30° C.  
 dilution ratios,  
     with toluene, 2.3  
     petroleum naphtha, 0.6  
     xylene, 1.9  
     mineral spirits, 0.9  
 vapor density, 4.07

METHYL "CELLOSOLVE" ACETYL  
RICINOLEATE

## Synonyms:

KP-120  
 methoxyethyl acetyl ricinoleate

## Formula:

$\text{C}_{17}\text{H}_{32}(\text{OOCCH}_3)\text{COOCH}_2\text{CH}_2\text{OCH}_3$

Characteristics: mild characteristic odor

Formula Weight: 398.0

## METHYL "CELLOSOLVE" ACETYL RICINOLEATE (Cont.)

## Melting Point:

gels at  $-60^{\circ}\text{C}$ .limpid liquid at  $-18^{\circ}\text{C}$ .Boiling Point:  $200$  to  $260^{\circ}\text{C}$ . (at 4 mm.)

## Specific Gravity:

 $0.965(20/20)$  $8.04$  lbs. per gal. at  $20^{\circ}\text{C}$ .Refractive Index:  $1.460$  at  $25^{\circ}\text{C}$ .Flash Point:  $424^{\circ}\text{F}$ . (open)

## Uses:

excellent solvent for polyvinyl resin

nitrocellulose is soluble in the cold

cellulose acetate is insoluble

copal ester, ethyl cellulose, Parlon

and Vinsol are soluble in the hot solvent

## Solubility:

approximately 3% (of water)

nearly none in water

 $\infty$  (in gasoline)  $\infty$  (in mineral oil)

slightly soluble in glycerine

insoluble or limited solubility in

glycols and some amines

soluble in most other organic solvents

## Additional Data:

fire point,  $485^{\circ}\text{F}$ .volatility at  $105^{\circ}\text{C}$ ., $2.0\%$  after 24 hours, $5.5\%$  after 100 hoursevaporation rate at  $105^{\circ}\text{C}$ ., $0.0032$  g. loss/sq. cm. after 24 hours, $0.0092$  g. loss/sq. cm. after 100 hours

hydrolysis,

none after refluxing with water for 2 hours

## METHYL "CELLOSOLVE" OLEATE

## Synonyms:

Kapsol

methoxyethyl oleate

## Formula:

 $\text{C}_8\text{H}_{17}\text{CHCH}(\text{CH}_2)_7\text{COOC}_2\text{H}_4\text{OCH}_3$ 

## Characteristics:

mild fatty characteristic odor

Formula Weight: 340.0

## Freezing Point:

 $-30^{\circ}\text{C}$ . partly crystallineBoiling Point:  $128$  to  $225^{\circ}\text{C}$ . (at 4 mm.)

## Specific Gravity:

 $0.902(20/20)$  $7.51$  lbs. per gal. at  $20^{\circ}\text{C}$ .Refractive Index:  $1.455$  at  $25^{\circ}\text{C}$ .Flash Point:  $360^{\circ}\text{F}$ . (open)

## Uses:

poor solvent for acetopropionate, cellulose acetate, and nitrocellulose  
solvent for acetobutyrate, copal ester, dammar, ethyl cellulose, Parlon, and Vinsol

compatible with nitrocellulose and polyvinyl resins in combination with other plasticizers

good plasticizer for chlorinated rubber

compatible with synthetic rubber

## Solubility:

approximately 3% (of water) at  $25^{\circ}\text{C}$ .nearly insoluble in water at  $25^{\circ}\text{C}$ . $\infty$  (in gasoline)  $\infty$  (in mineral oil)

slightly soluble or limited solubility

in glycerine, glycols, and certain amines

soluble in most other organic solvents

## Additional Data:

fire point,  $428^{\circ}\text{F}$ .volatility at  $105^{\circ}\text{C}$ ., $2.1\%$  after 24 hours $12.5\%$  after 100 hoursevaporation rate at  $105^{\circ}\text{C}$ ., $0.0035$  g. loss/sq. cm. after 24 hours, $0.0210$  g. loss/sq. cm. after 100 hours

hydrolysis,

 $0.05\%$  after refluxing with water for 2 hours

## METHYL CHLOROACETATE

## Synonyms:

chloroacetic acid methyl ester

methyl chloroethanoate

methyl monochloroacetate

Formula:  $\text{CH}_2\text{ClCOOCH}_3$

**Characteristics:**

sweetish odor which becomes rapidly  
sharp and stringent  
irritates the eyes and mucous  
membranes

**Formula Weight:** 108.5

**Melting Point:**

-32.7° C.                      -31.9° C.

**Boiling Point:**

130 to 132° C. (at 760 mm.)

131.5° C. (at 760 mm.)

130° C. (at 740 mm.)

**Specific Gravity:**

1.236(20/4)                      1.232(25/25)

1.227(25/4)

10.3 lbs. per gal. at 20° C.

**Viscosity (centipoises):**

1.042 at 25° C.                      0.050 at 60° C.

**Flash Point:** 122° F. (open)

**Specific Heat** (gram-calories per g.  
per ° C.): 0.383 (liquid)

**Heat of Vaporization:**

78.2 gram-calories per g.

141 Btu. per lb.

**Uses:**

organic syntheses      solvent

**Solubility** (grams per 100 ml.):

5.0 (of water) at 80° C.

very slightly soluble in water

∞ (in alcohol)                      ∞ (in carbon

∞ (in ether)                      tetrachloride)

miscible with most organic solvents

**Additional Data:** fire point, 131° F.

**METHYL o-CHLOROBENZOATE****Synonyms:**

o-chlorobenzoic acid methyl ester

**Formula:**  $\text{ClC}_6\text{H}_4\text{COOCH}_3$

**Formula Weight:** 170.6

**Boiling Point:** 234.5° C. (at 760 mm.)

**METHYL CHLOROFORMATE****Synonyms:**

chloroformic acid methyl ester

methyl chlorocarbonate

methyl chloromethanoate

**Formula:**  $\text{ClCOOCH}_3$

**Characteristics:** highly irritant

**Formula Weight:** 94.5

**Boiling Point:**

71 to 72° C. (at 760 mm.)

71.4° C. (at 760 mm.)

**Specific Gravity:** 1.236(15/4)

**Uses:**

insecticides

organic syntheses

lachrymator

**Solubility:**

decomposes in water

∞ (in alcohol)                      ∞ (in ether)

very soluble in chloroform

very soluble in benzene

**Additional Data:** vapor density, 3.9

**METHYL CHLOROSULFONATE**

**Formula:**  $\text{CH}_3\text{OSO}_2\text{Cl}$

**Characteristics:**

highly irritant                      pungent odor

**Formula Weight:** 130.5

**Melting Point:** -70° C.

**Boiling Point:**

133 to 135° C. (at 760 mm.) decomposes

**Specific Gravity:** 1.492 at 10° C.

**Uses:**

lachrymator

organic syntheses

**Solubility:**

insoluble and decomposes in water

soluble in alcohol, chloroform, and

carbon tetrachloride

**Additional Data:**

vapor density, 4.5

volatility,

60,000 mg per cu. m. at 20° C.

## METHYL CROTONATE

## Synonyms:

crotonic acid methyl ester  
methyl  $\alpha$ -crotonate

Formula:  $C_3H_5COOCH_3$

Formula Weight: 100.1

## Boiling Point:

120.7° C. (at 760 mm.)  
120° C. (at 760 mm.)

Specific Gravity: 0.981(4/4)

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## METHYL CYANOACETATE

## Synonyms:

cyanoacetic acid methyl ester  
methyl cyanoethanoate  
cyanoethanoic acid methyl ester

Formula:  $CNCH_2COOCH_3$

Formula Weight: 99.1

Melting Point: -22.5° C.

## Boiling Point:

200° C. (at 760 mm.)  
203° C. (at 760 mm.)

Specific Gravity: 1.123(15/4)

## Solubility:

insoluble in water     $\infty$  (in ether)

## METHYL CYANOFORMATE

## Synonyms:

cyanomethylcarbonate  
cyanofornic acid methyl ester  
methyl cyanomethanoate

Formula:  $CHCOOCH_3$

Characteristics: ethereal odor

Formula Weight: 85.0

Boiling Point: 100° C. (at 760 mm.)

Specific Gravity: 1.00 at 20° C.

Uses: organic syntheses

## Solubility:

decomposes in water  
soluble in alcohol, ether, alkalies, and  
benzene

## METHYLCYCLOBUTANE

Synonyms: methyl tetramethylene

Formula:  $CH_3CHCH_2CH_2CH_2$

Formula Weight: 70.1

## Boiling Point:

35 to 36° C. (at 753 mm.)  
39 to 42° C. (at 760 mm.)

## Specific Gravity:

0.6931 at 20° C.    0.694(20/4)

Refractive Index: 1.3836 at 20° C.

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

## METHYLCYCLOHEXANE

## Synonyms:

cyclohexylmethane  
hexahydrotoluene  
toluene hexahydride

Formula:  $CH_3CHC_5H_{10}$

## Characteristics:

characteristic aromatic odor

Formula Weight: 98.2

## Melting Point:

-126.4° C.    < -120° C.

## Boiling Point:

101° C. (at 760 mm.)  
100.3° C. (at 760 mm.)  
100 to 103° C. (at 760 mm.)

## Specific Gravity:

0.7864(0/4)    0.768(25/25)  
0.769(20/4)    6.4 lbs. per gal.

## Refractive Index:

1.4235    1.421 at 25° C.  
1.42312

## Viscosity (centipoises):

0.72 at 25° C.    0.47 at 60° C.

Formula:  $\text{CH}_3\text{C}_6\text{H}_{10}\text{OH}$

insoluble in water      soluble in ether  
soluble in alcohol

dl-3-METHYLCYCLOHEXANONE

Formula:  $\text{COCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_2$

Formula Weight: 112.2

Boiling Point:  
168° C. (at 760 mm.)  
168 to 169° C. (at 738 mm.)

Specific Gravity:  
0.9136                      0.921(19/4)

Refractive Index: 1.4430

Solubility:  
insoluble in water      soluble in alcohol  
                                     soluble in ether

4-METHYLCYCLOHEXANONE

Formula:  $\text{COCH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2$

Formula Weight: 112.2

Boiling Point: 169 to 170° C. (at 760 mm.)

Specific Gravity: 0.912(24/4)

Refractive Index: 1.44322 at 24.4° C.

Solubility:  
insoluble in water      soluble in alcohol  
                                     soluble in ether

METHYLCYCLOHEXANONE

Synonyms:  
methylanon  
"Sextone" B  
a commercial mixture

Characteristics:  
colorless to pale yellow  
odor dimilar to acetone

Formula Weight: 112.2

Boiling Point:  
160 to 170° C. (at 760 mm.)  
114 to 173° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 4 at 30° C.

Specific Gravity:  
0.921 at 20° C.              0.925  
7.67 lbs. per gal. at 20° C.

Flash Point:  
145° F. (open)              118° F. (closed)

Uses:  
solvent                      lacquers

Additional Data:  
very similar to cyclohexanone in  
miscibility, physical properties, and  
solvent properties  
coefficient of expansion,  
0.00085 at 10 to 30° C.  
vapor density, 4.86  
dilution ratios:  
with benzene, 5.5  
toluene, 5.5  
xylene, 7.0, 4.5  
mineral spirits, 1.0

METHYLCYCLOHEXENE

Synonyms:  
 $\Delta^1$ -methylcyclohexene  
toluenetetrahydride

Formula:  $\text{CH}_3\text{C}_6\text{H}_9$

Formula Weight: 96.2

Boiling Point: 110 to 111° C. (at 760 mm.)

Specific Gravity: 0.809(20/4)

Solubility:  
insoluble in water      soluble in alcohol  
                                     soluble in ether

4-METHYLCYCLOHEXENE

Synonyms:  
 $\Delta^3$ -methylcyclohexene  
1, 2, 3, 6-tetrahydrotoluene  
toluene tetrahydride

Formula:  $\text{CH}:\text{CHCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2$

Formula Weight: 96.2

Boiling Point: 102 to 103° C. (at 760 mm.)

Specific Gravity:  
0.841(15/4)                      0.800(20/20)  
0.801(20/4)

Solubility:  
insoluble in water      soluble in alcohol  
                                     soluble in ether

## METHYLCYCLOHEXYL ACETATE

## Synonyms:

heptalin acetate  
 hexahydrocresol acetate  
 hexahydromethylphenol acetate  
 methylcyclohexanol acetate  
 methylhexalin acetate  
 "Sextate"

Formula:  $\text{CH}_3\text{COOC}_7\text{H}_{13}$

Characteristics: ester-like odor

Formula Weight: 156.2

Boiling Point:  $176$  to  $193^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.941

Flash Point:  $147^\circ\text{F}$ . (closed)

## Uses:

lacquers  
 solvent for bitumens, basic dyes, fats,  
 nitrocellulose, oils, resins, rubber,  
 and waxes

## Additional Data:

evaporation rate is slower than that of  
 amyl acetate  
 dilution ratio,  
     with toluene, 2.5  
 vapor density, 5.37

## METHYLCYCLOHEXYL LACTATE

## Synonyms:

heptalin lactate  
 hexahydrocresol lactate  
 hexahydromethylphenol lactate  
 methylcyclohexanol lactate  
 methylhexalin lactate  
 "Sextol" lactate

Characteristics: nearly odorless

Specific Gravity: 1.02

Flash Point:  $208^\circ\text{F}$ . (closed)

## Uses:

lacquers  
 solvent for cellulose ethers, chlorin-  
 ated rubber, dyes, fats, nitro-  
 cellulose, oils, and resins

## Solubility:

miscible with the usual organic  
 solvents

## METHYLCYCLOPENTANE

Formula:  $\text{CH}_3\text{CHC}_4\text{H}_8$

Formula Weight: 84.2

## Melting Point:

$-140.5^\circ\text{C}$ .                       $-143.0^\circ\text{C}$ .  
 $-142.4^\circ\text{C}$ .

## Boiling Point:

$71.8^\circ\text{C}$ . (at 760 mm.)  
 $72^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.7488(20/4)

## Refractive Index:

1.4098                      1.40970

Specific Heat (Btu. per lb. per  $^\circ\text{F}$ .):

0.447 (liquid) at  $69.3^\circ\text{F}$ .

Heat of Vaporization (Btu. per lb.):

149.6 at the boiling point  
 161.59 at  $77^\circ\text{F}$ .

Uses: organic syntheses

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
     $\infty$  (in benzene)  
 very soluble in ether

## Additional Data:

specific gravity of gas (ideal)  
     (air = 1.0), 2.9053  
 specific gravity of liquid (in vacuo),  
     0.74864(20/4) $^\circ\text{C}$ . 0.75354(60/60) $^\circ\text{F}$ .  
 API gravity at  $60^\circ\text{F}$ ., 56.3  
 liquid density (in vacuo) at  $60^\circ\text{F}$ .,  
     6.2825 lbs./gal.  
 aniline point,  $91.4^\circ\text{F}$ .  
 critical temperature,  $499.3^\circ\text{F}$ .  
 critical pressure, 549.1 psia.  
 coefficient of expansion,  
     0.00068 at 32 to  $104^\circ\text{F}$ .  
 total heating values ( $77^\circ\text{F}$ .),  
     20,100 Btu./lb.,  
     124,800 Btu./cu. ft.-gas

## METHYLDICHLOROARSINE

## Synonyms:

Methyldick MD

Formula:  $\text{CH}_3\text{AsCl}_2$ 

## Characteristics:

mobile liquid highly irritant  
agreeable, characteristic odor

Formula Weight: 160.9

## Melting Point:

 $-42.5^\circ\text{C}$ .  $-59^\circ\text{C}$ .

## Boiling Point:

 $132$  to  $133^\circ\text{C}$ . (at 760 mm.)  
 $133$  to  $136^\circ\text{C}$ . (at 760 mm.)Vapor Pressure (mm. Hg):  $8.5$ 

Specific Gravity: 1.838(20/4)

## Solubility:

slightly soluble in water, decomposes  
soluble in alcohol, ether, and benzene

## Additional Data:

vapor density,  $5.5$   
volatility,  $74,440$  mg./cu. m. at  $20^\circ\text{C}$ .  
coefficient of expansion,  $0.00102$ 

## METHYL DIHYDROABIETATE

## Synonyms:

"Hercolyn" 92 to 94% ester

Formula:  $\text{C}_{19}\text{H}_{31}\text{COOCH}_3$ 

## Characteristics:

very faint mild ester-like odor  
viscous

Formula Weight: 318.0

## Melting Point:

does not freeze at  $-40^\circ\text{C}$ ., but becomes  
very viscous at low temperaturesBoiling Point:  $365$  to  $370^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

 $1.020$  to  $1.030$  at  $20^\circ\text{C}$ .  
 $1.032(20/20)$   $8.53$  lbs. per gal.Refractive Index:  $1.517$  to  $1.519$ Viscosity (poises):  $28$  to  $34$ Flash Point:  $361.4^\circ\text{F}$ . (open)

## Uses:

organic coatings printing inks  
adhesives polishes  
plastics  
perfume fixative and carrier  
leather and artificial leather  
nitrocellulose lacquers

## Additional Data:

acid number,  $6$  or  $<6$   
saponification number,  $20$  to  $25$   
flame point,  $424.4^\circ\text{F}$ .  
thiocyanogen value,  $35$  to  $40$   
specific rotation,  $+36$   
dielectric constant,  
 $3.5$  at  $25^\circ\text{C}$ .  $3.14$  at  $100^\circ\text{C}$ .  
power factor, 60 cycles,  
 $0.9\%$  at  $25^\circ\text{C}$ .  $20.5\%$  at  $100^\circ\text{C}$ .  
dielectric strength,  
 $27.5$  KV (0.01" gap at  $100^\circ\text{C}$ .)  
 $26.5$  KV (0.01" gap at  $25^\circ\text{C}$ .)

## 2-METHYL-m-DIOXANE

Synonyms: trimethyleneacetal

Formula:  $\text{CH}_3\text{CHO}(\text{CH}_2)_3\text{O}$ 

Formula Weight: 102.1

Boiling Point:  $109$  to  $111^\circ\text{C}$ . (at 760 mm.)

## Solubility:

soluble in water, alcohol, and ether

## 2-METHYL-1,3-DIOXOLANE

## Synonyms:

ethylene ethylidene ether  
ethylene ethylidene oxide  
glycol ethylidene ether  
glycol ethylidene diacetalFormula:  $\text{OCH}(\text{CH}_3)\text{OCH}_2\text{CH}_2$ 

Formula Weight: 88.1

## Boiling Point:

 $81^\circ\text{C}$ . (at 760 mm.)  
 $82.5^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

 $0.982(20/24)$   $0.987(15/4)$   
 $1.002(0/4)$   
 $8.2$  lbs. per gal. at  $20^\circ\text{C}$ .



Boiling Point: 122.3° C. (at 760 mm.)  
 Specific Gravity: 1.103(20/4)  
 Solubility (grams per 100 ml.):  
     3.1 (in water)

#### METHYL $\beta$ -ETHYLACROLEIN ( $\alpha$ )

Synonyms: 2-methyl-pentene-2-ol-1  
 Formula:  $C_2H_5CHC(CH_3)CHO$   
 Formula Weight: 98.1  
 Boiling Point: 137.3° C. (at 759 mm.)  
 Specific Gravity: 0.854(25/4)  
 Solubility: insoluble in water

#### METHYL ETHYL ETHYLPHENYLMALONATE

Formula:  
 $CH_3OCC(C_6H_5)(C_2H_5)COOC_2H_5$   
 Characteristics: yellow  
 Formula Weight: 250.3  
 Boiling Point: 165 to 170° C. (at 20 mm.)  
 Solubility:  
     insoluble in water      soluble in alcohol  
                                     soluble in ether

#### 2-METHYL-4-ETHYLTHIOPHENE

Formula:  $C_7H_{10}S$   
 Melting Point: -59° C.  
 Boiling Point: 163° C. (at 760 mm.)  
 Specific Gravity:  
     0.974 at 20° C.      0.970 at 25° C.  
 Refractive Index:  
     1.510 at 20° C.      1.507 at 25° C.

#### 2-METHYL-5-ETHYLTHIOPHENE

Formula:  $C_7H_{10}S$   
 Melting Point: -69° C.  
 Boiling Point:  
     160° C. (at 760 mm.)  
     38° C. (at 10 mm.)

Specific Gravity:  
     0.967 at 20° C.      0.962 at 25° C.  
 Refractive Index:  
     1.507 at 20° C.      1.505 at 25° C.

#### METHYL FLUOROFORMATE

Synonyms: fluoroformic acid methyl ester  
 Formula:  $FCOOCH_3$   
 Characteristics: highly irritant  
 Formula Weight: 78.0  
 Boiling Point: 40° C. (at 760 mm.)  
 Specific Gravity: 1.06 at 33° C.

#### METHYL FLUROSULFONATE

Synonyms:  
     fluorosulfonic acid methyl ester  
 Formula:  $CH_3OSO_2F$   
 Characteristics: ethereal odor  
 Formula Weight: 114.0  
 Boiling Point: 92° C. (at 716 mm.)  
 Specific Gravity: 1.427 at 16° C.  
 Uses: organic syntheses  
 Solubility: insoluble in water  
 Additional Data:  
     saponifies readily      attacks glass

#### N-METHYLFORMANILIDE

Formula:  $C_6H_5(CH_3)NCHO$   
 Formula Weight: 135.2  
 Melting Point: 13° C.  
 Boiling Point: 253° C. (at 716 mm.)  
 Specific Gravity: 1.095(20/4)  
 Solubility:  
     very slightly soluble in water  
     very soluble in alcohol

## METHYL FORMATE

## Synonyms:

formic acid methyl ester  
methyl methanoate

Formula:  $\text{HCOOCH}_3$

## Characteristics:

agreeably fruity, pleasant, ethereal  
odor, which is somewhat irritating  
bitter taste plum flavor

Formula Weight: 60.1

## Melting Point:

-99.0° C. -99.8° C.

## Boiling Point:

31.8° C. (at 760 mm.)  
31.5° C. (at 760 mm.)  
32° C. (at 760 mm.)  
31.5 to 35.0° C. (at 760 mm.)

## Specific Gravity:

0.98149(15/4) 0.950 to  
0.975(20/4) 0.980(20/20)  
8.03 lbs. per gal. at 20° C.

## Refractive Index:

1.3440 1.3431

## Inflammability Range (volume per cent in air):

5.9, 5.0 (lower limit)  
20, 23 (upper limit)

## Flash Point:

-25.6° F. (open) -2° F. (closed)

## Uses:

organic syntheses  
fumigant and larvicide for treatment  
of cereals, dried fruits, tobacco, etc.  
solvent for cellulose acetate

## Solubility (grams per 100 ml.):

24.4 (of water) at 25° C.  
30.4 (in water) at 20° C.  
soluble in ether  $\infty$  (in alcohol)  
soluble in methyl alcohol

## Additional Data:

electrical conductivity,  
3.6 x 10<sup>-5</sup> mhos at 25° C.  
autoignition temperature, 840° F.  
vapor density, 2.07  
critical temperature, 214.0° C.  
critical pressure, 59.1 atm.

## 5-METHYL-2-FURALDEHYDE

## Synonyms:

5-methylfurfural  
methylfurfural (2, 5)  
5-methyl furfurole

Formula:  $\text{CH}_3\text{C}_4\text{H}_2\text{OCHO}$

## Characteristics: oily

Formula Weight: 110.1

## Boiling Point:

186 to 187° C. (at 760 mm.)  
106 to 107° C. (at 60 mm.)

## Specific Gravity:

1.072(18/4) 1.109(18/18)

## Solubility (grams per 100 ml.):

3.3 (in water)  $\infty$  (in ether)  
very soluble in alcohol

## 2-METHYLFURAN

## Synonyms:

methylfurfurane (2)  
silvan sylvan(e)

Formula:  $\text{C}_4\text{H}_3\text{OCH}_3$

Formula Weight: 82.1

## Boiling Point:

65° C. (at 759 mm.)  
62 to 63° C. (at 760 mm.)

## Specific Gravity: 0.916

## Solubility:

insoluble in water soluble in alcohol  
soluble in ether

## 3-METHYLFURAN

Formula:  $\text{C}_4\text{H}_3\text{OCH}_3$

Formula Weight: 82.1

Boiling Point: 65.5° C. (at 760 mm.)

Specific Gravity: 0.923(18/4)

## Solubility:

soluble in alcohol soluble in ether



## METHYL 10-HENDECENOATE (Cont.)

Formula Weight: 198.3

Melting Point:  $-27.5^{\circ}\text{C}$ .Boiling Point:  $248.9^{\circ}\text{C}$ . (at 760 mm.)Specific Gravity: 0.889 at  $15^{\circ}\text{C}$ .

## 2-METHYLHEPTANE

Synonyms:

amyldimethylmethane

isooctane

octane

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_4\text{CH}_3$ 

Formula Weight: 114.2

Melting Point:

 $-111.3^{\circ}\text{C}$ . $-109.5^{\circ}\text{C}$ .

Boiling Point:

 $117.2^{\circ}\text{C}$ . (at 760 mm.) $116.0^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.698 to 0.7029(20/4)

Refractive Index: 1.3935

Uses: organic syntheses

Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## 3-METHYLHEPTANE

Synonyms:

butyl ethyl methylmethane

octane

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 114.2

Melting Point:  $-120.8^{\circ}\text{C}$ .

Boiling Point:

 $119.0^{\circ}\text{C}$ . (at 760 mm.) $122.2^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.705(20/4)

0.7161

Uses: organic syntheses

Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## 4-METHYLHEPTANE

Synonyms:

methyldipropylmethane

octane

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{CH}_3)(\text{CH}_2)_2\text{CH}_3$ 

Formula Weight: 114.2

Melting Point:  $-121.1$ 

Boiling Point:

 $117.7^{\circ}\text{C}$ . (at 760 mm.) $118.0^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.717 to 0.7211(20/4)

Refractive Index: 1.398 at  $15^{\circ}\text{C}$ .

Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## 2-METHYL-2-HEPTANOL

Synonyms:

amyldimethylcarbinol

2-methylheptanol-2

Formula:  $(\text{CH}_3)_2\text{COH}(\text{CH}_2)_4\text{CH}_3$ 

Formula Weight: 130.2

Boiling Point:  $162^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.879(20/4)

Refractive Index: 1.4303

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## 3-METHYL-3-HEPTANOL

Synonyms:

butylethylmethylcarbinol

3-methylheptanol-3

Formula:  $\text{CH}_3\text{CH}_2\text{COH}(\text{CH}_3)(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 130.2

Boiling Point:

 $163.5^{\circ}\text{C}$ . (at 760 mm.) $162^{\circ}\text{C}$ . (at 760 mm.) $65.8^{\circ}\text{C}$ . (at 15 mm.)

Specific Gravity:

0.820 at  $21^{\circ}\text{C}$ .

0.8282(20/4)

Refractive Index: 1.4279

Solubility:

very slightly soluble in water  
soluble in alcohol    soluble in ether

#### 4-METHYL-4-HEPTANOL

Synonyms:

methyldipropylcarbinol  
4-methylheptanol-4

Formula:



Formula Weight: 130.2

Boiling Point: 161.5° C. (at 760 mm.)

Specific Gravity: 0.8248(20/4)

Refractive Index: 1.427

Solubility:

insoluble in water    soluble in alcohol  
                              soluble in ether

#### 6-METHYL-3-HEPTANONE

Synonyms: ethyl isoamyl ketone

Formula:  $\text{C}_2\text{H}_5\text{COCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 128.2

Boiling Point: 163.5° C. (at 760 mm.)

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

#### 2-METHYL-4-HEPTANONE

Synonyms: isobutyl propyl ketone

Formula:



Formula Weight: 128.2

Boiling Point: 155° C. (at 760 mm.)

Specific Gravity: 0.813(22/0)

Solubility:

insoluble in water  
slightly soluble in chloroform  
soluble in alcohol, ether, alkalies, and  
acetone

#### 2-METHYL-2-HEPTENE

Synonyms:

octylene                      2-methylheptene-2

Formula:  $(\text{CH}_3)_2\text{C}:\text{CHCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 112.2

Boiling Point: 122.4° C. (at 756 mm.)

Specific Gravity: 0.725(20/0)

Solubility: insoluble in water

#### 1-METHYLHEPTYLAMINE

Synonyms:

2-aminooctane              sec-n-caprylamine  
                                      sec-n-octylamine

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}(\text{CH}_3)\text{NH}_2$

Formula Weight: 129.2

Boiling Point: 164 to 166° C. (at 760 mm.)

Specific Gravity:

0.771(25/4)                      0.7721(20/4)

Refractive Index: 1.4254

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

#### 2-METHYLHEXANE

Synonyms:

ethylisobutylmethane  
isoheptane

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 100.2

Melting Point:

-118.2° C.                      -119.1° C.

Boiling Point: 90.00° C. (at 760 mm.)

Specific Gravity: 0.6789(20/4)

Refractive Index:

1.38498                      1.38940

Specific Heat (Btu. per lb. per ° F.):

0.523 (liquid) at 66° F.

## 2-METHYLHEXANE (Cont.)

Heat of Vaporization (Btu. per lb.):

132.0 at the boiling point

149.33 at 77° F.

Uses: organic syntheses

Solubility:

insoluble in water    soluble in alcohol  
very soluble in ether

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 3.4592

specific gravity of liquid (in vacuo),

0.67865(20/4)° C.    0.68314(60/60)° F.

API gravity (at 60° F.), 75.6

liquid density (in vacuo) at 60° F.,

5.6954

aniline point, 163.0

critical temperature, 496.2° F.

critical pressure, 400.0 psia.

coefficient of expansion,

0.00070 at 68° F.

total heating values (at 77° F.),

20,645 Btu./lb.,

116,180 Btu./cu. ft.-gas,

## 3-METHYLHEXANE

Synonyms:

ethylmethylpropylmethane

heptane

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3$ 

Formula Weight: 100.2

Melting Point: -119.4° C.

Boiling Point:

89.4° C. (at 760 mm.)

91.8° C. (at 760 mm.)

Specific Gravity:

0.6957(20/4)

0.687(20/4)

Refractive Index: 1.38865

Specific Heat (Btu. per lb. per ° F.):

0.511 (liquid) at 61.2° F.

Heat of Vaporization (Btu. per lb.):

132.2 at the boiling point

150.53 at 77° F.

Solubility:

insoluble in water    soluble in alcohol

very soluble in ether

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 3.4592

specific gravity of liquid (in vacuo),

0.6870(20/4)° C.    0.6914(60/60)° F.

API gravity (at 60° F.), 73.2

liquid density (in vacuo) at 60° F., 5.7

aniline point, 158.9

critical temperature, 504.3° F.

critical pressure, 413.0 psia.

coefficient of expansion,

0.00068 at 68° F.

total heating values (at 77° F.),

20,655 Btu./lb.,

117,690 Btu./cu. ft.-gas

## 2-METHYL-1-HEXANOL

Synonyms: 2-methylhexanol-1

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$ 

Formula Weight: 116.2

Boiling Point: 162 to 164° C. (at 750 mm)

Specific Gravity: 0.831(13/4)

Solubility:

insoluble in water    ∞ (in alcohol)

∞ (in ether)

## 5-METHYL-1-HEXANOL

Synonyms:

isoheptyl alcohol    5-methylhexanol

isohexyl carbinol    2-methylhexanol

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{CH}_2\text{OH}$ 

Formula Weight: 116.2

Boiling Point: 167 to 169° C. (at 760 mm)

Specific Gravity:

0.8311(0/4)

0.825(11.5/4)

Refractive Index: 1.4254

Solubility:

very slightly soluble in water

very soluble in alcohol

very soluble in ether

## 2-METHYL-2-HEXANOL

## Synonyms:

butyldimethylcarbinol  
2-methylhexanol-2

Formula:  $\text{CH}_3\text{COH}(\text{CH}_3)(\text{CH}_2)_3\text{CH}_3$

Formula Weight: 116.2

## Boiling Point:

139.4 to 140.4° C. (at 735 mm.)  
141 to 142° C. (at 755 mm.)

## Specific Gravity:

0.816                      0.8119(20/4)

Refractive Index: 1.4175

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)             $\infty$  (in ether)

## 5-METHYL-2-HEXANOL

## Synonyms:

isoamylmethylcarbinol  
5-methylhexanol-2  
2-methylhexanol-5

Formula:  $\text{CH}_3\text{CHOH}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 116.2

Boiling Point: 148 to 150° C. (at 760 mm.)

Specific Gravity: 0.8155(17/4)

## Solubility:

insoluble in water      soluble in alcohol  
                                 soluble in ether

## 2-METHYL-3-HEXANOL

Synonyms: 2-methylhexanol-3

Formula:  $(\text{CH}_3)_2\text{CHCHOH}(\text{CH}_2)_2\text{CH}_3$

Characteristics: oily

Formula Weight: 116.2

Boiling Point: 145 to 146° C. (at 760 mm.)

Specific Gravity: 0.827(16.7/4)

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

## 3-METHYL-3-HEXANOL

## Synonyms:

ethylmethylpropylcarbinol  
3-methylhexanol-3

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{COH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

Formula Weight: 116.2

## Boiling Point:

140.3° C. (at 745 mm.)  
141° C. (at 760 mm.)

## Specific Gravity:

0.828(18/4)                      0.8234(20/4)

Refractive Index: 1.423

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## 5-METHYL-3-HEXANOL

## Synonyms:

ethylisobutylcarbinol  
2-methyl-4-hexanol

Formula:  $\text{CH}_3\text{CH}_2\text{CHOHCH}_2\text{CH}(\text{CH}_3)_2$

Formula Weight: 116.2

## Boiling Point:

147 to 148° C. (at 756 mm.)  
148.2° C. (at 760 mm.)

## Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## 3-METHYL-4-HEXANOL

Synonyms: 3-methylhexanol-4

Formula:  $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{CHOHC}_2\text{H}_5$

Formula Weight: 116.2

Boiling Point: 149 to 150° C. (at 760 mm.)

Specific Gravity: 0.852 at 0° C.

## Solubility:

insoluble in water      soluble in alcohol  
                                 soluble in ether

## 5-METHYL-2-HEXANONE

## Synonyms:

isoamyl methyl ketone  
2-methylhexanone-5  
methyl isoamyl ketone

Formula:  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 114.2

Boiling Point: 144° C. (at 760 mm.)

## Specific Gravity:

0.818(17/4) 0.813 at 20° C.

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## 5-METHYL-2-HEXANONE OXIME

## Synonyms: methyl isoamyl ketoxime

Formula:  $\text{CH}_3\text{C}(\text{:NOH})\text{C}_5\text{H}_{11}$ 

## Characteristics:

colorless to yellow  
oily

Formula Weight: 129.2

## Boiling Point:

195 to 196° C. (at 761 mm.) decomposes

Specific Gravity: 0.888(20/4)

## 5-METHYL-3-HEXANONE

## Synonyms: ethyl isobutyl ketone

Formula:  $\text{C}_2\text{H}_5\text{COCH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 114.2

## Boiling Point:

136° C. (at 760 mm.)  
135° C. (at 755 mm.)

Specific Gravity: 0.815(19/0)

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## METHYLHYDRAZINE

Formula:  $\text{CH}_3\text{NHNH}_2$ 

Characteristics: hygroscopic

Formula Weight: 46.1

## Boiling Point:

87° C. (at 745 mm.)  
87.5° C. (at 760 mm.)

## Solubility:

soluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## METHYL 3-HYDROXYBUTYRATE

## Synonyms:

3-hydroxybutyric acid methyl ester  
methyl 3-hydroxybutanoate

Formula:  $\text{CH}_3\text{CHOHCH}_2\text{COOCH}_3$ 

Formula Weight: 118.1

Boiling Point: 174.9° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 0.85 at 20° C.

## Specific Gravity:

1.0559(20/20)  
8.8 lbs. per gal. at 20° C.

Flash Point: 180° F. (open)

## Uses:

possible organic syntheses of pharmaceuticals, plasticizers

## Solubility:

$\infty$  (of water)  $\infty$  (in water)

## METHYL 2-HYDROXYISOBUTYRATE

## Synonyms:

2-hydroxyisobutyric acid methyl ester  
methyl 2-hydroxyisobutyrate

Formula:  $(\text{CH}_3)_2\text{COHCOOCH}_3$ 

Formula Weight: 118.1

Boiling Point: 135 to 137° C. (at 760 mm.)

Specific Gravity: 1.025(15/15)

Refractive Index: 1.4092

## Uses:

organic syntheses excellent solvent

## Solubility:

$\infty$  (in water)  
miscible with most organic solvents

Additional Data:  
purity (by saponification number), 98.5  
acidity, 0.2%

1-METHYLMIDAZOLE

Synonyms: methylglyoxaline  
Formula:  $\text{CH}_3\text{NCH:NCH:CH}$   
Formula Weight: 82.1  
Melting Point:  $-6^\circ\text{C}$ .  
Boiling Point:  $197$  to  $199^\circ\text{C}$ . (at  $760\text{ mm.}$ )  
Specific Gravity:  $1.036$  at  $10^\circ\text{C}$ .  
Solubility:  $\infty$  (in water)

2, 2-METHYLMINODIETHANOL

Synonyms: methyldiethanolamine  
Formula:  $\text{CH}_3\text{N}(\text{C}_2\text{H}_4\text{OH})_2$   
Characteristics:  
light color  
characteristic amine-like odor  
Formula Weight: 119.2  
Solidification Point:  $-19^\circ\text{C}$ .

Boiling Point:  
 $247.2^\circ\text{C}$ . (at  $760\text{ mm.}$ )  
 $240$  to  $260^\circ\text{C}$ . (at  $760\text{ mm.}$ )  
 $246$  to  $248^\circ\text{C}$ . (at  $760\text{ mm.}$ )  
 $121^\circ\text{C}$ . (at  $4\text{ mm.}$ )

Vapor Pressure (mm. Hg):  
 $<0.01$  at  $20^\circ\text{C}$ .  
Specific Gravity:  
 $1.037$  at  $25^\circ\text{C}$ .  $1.043(20/20)$   
 $8.7\text{ lbs. per gal.}$  at  $20^\circ\text{C}$ .

Refractive Index:  
 $1.4699$   $1.468$

Viscosity (centipoises): 83 at  $25^\circ\text{C}$ .

Flash Point:  $260^\circ\text{F}$ . (open)

Uses:  
organic syntheses of dyes, corrosion  
inhibitors, emulsifying agents,  
insecticide intermediates, textile  
assistants  
absorbing agent for acid gases

Solubility:  
 $\infty$  (of water)  $\infty$  (in benzene)  
 $\infty$  (in water)

Additional Data:  
coefficient of expansion,  
 $0.00066$  per  $^\circ\text{C}$ .

1-METHYLINDOLE

Formula:  $\text{C}_9\text{H}_9\text{N}$   
Formula Weight: 131.2  
Melting Point:  $<-20^\circ\text{C}$ .  
Boiling Point:  $242.4^\circ\text{C}$ . (at  $760\text{ mm.}$ )  
Specific Gravity:  $1.071$  at  $0^\circ\text{C}$ .

Solubility:  
insoluble in water  
very soluble in alcohol  
very soluble in ether

METHYL o-IODOBENZOATE

Synonyms:  
o-iodobenzoic acid methyl ester  
Formula:  $\text{IC}_6\text{H}_4\text{COOCH}_3$   
Formula Weight: 262.1  
Boiling Point:  $277$  to  $278^\circ\text{C}$ . (at  $760\text{ mm.}$ )

METHYL ISOBUTYLCARBINOL  
ACETATE

Synonyms: hexyl acetate  
Formula:  $\text{CH}_3\text{COOCH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_3)_2$   
Formula Weight: 144.2  
Boiling Point:  $146$  to  $147^\circ\text{C}$ . (at  $760\text{ mm.}$ )  
Specific Gravity:  $0.860(20/20)$   
Solubility (grams per 100 ml.):  
 $0.13$  (in water) at  $20^\circ\text{C}$ .

METHYL ISOBUTYRATE

Synonyms:  
isobutyric acid methyl ester  
methyl 2-methylpropanoate  
Formula:  $(\text{CH}_3)_2\text{CHCOOCH}_3$

## METHYL ISOBUTYRATE (Cont.)

## Characteristics:

distinct fruity odor  
sweet taste  
apricot flavor

Formula Weight: 102.1

Melting Point:  $-84.7^{\circ}\text{C.}$ 

## Boiling Point:

92 to  $93^{\circ}\text{C.}$  (at 760 mm.)  
 $92.6^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity: 0.891(20/4)

Refractive Index: 1.3840

## Uses:

synthetic apricot, banana, date, pear,  
and pineapple flavors

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## Additional Data:

critical temperature,  $267.3^{\circ}\text{C.}$   
critical pressure, 33.9 atm.

## METHYL ISOCYANATE

## Synonyms:

isocyanic acid methyl ester  
methyl carbonimide

Formula:  $\text{CH}_3\text{NCO}$ 

Formula Weight: 57.1

Boiling Point: 43 to  $45^{\circ}\text{C.}$  (at 760 mm.)

## METHYL ISOCYANIDE

## Synonyms:

methylcarbylamine  
methyl isonitrile

Formula:  $\text{CH}_3\text{NC}$ 

Formula Weight: 41.1

Melting Point:  $-45^{\circ}\text{C.}$ Boiling Point:  $59.6^{\circ}\text{C.}$  (at 760 mm.)

## Specific Gravity:

0.756 at  $4^{\circ}\text{C.}$  0.7464(20/4)

Solubility (grams per 100 ml.):

10 (in water) at  $15^{\circ}\text{C.}$ soluble in alcohol  $\infty$  (in ether)

## METHYL ISOSUCCINATE

Synonyms: isosuccinic acid methyl ester

Formula:  $\text{CH}_3\text{CH}(\text{COOCH}_3)_2$ 

Formula Weight: 146.1

Boiling Point:  $179^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity: 1.028(25/25)

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## METHYL ISOVALERATE

## Synonyms:

isovaleric acid methyl ester  
methyl 3-methylbutanoate

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{COOCH}_3$ 

## Characteristics:

pronounced fruity odor  
bitter taste apple flavor

Formula Weight: 116.2

## Boiling Point:

$116.7^{\circ}\text{C.}$  (at 760 mm.)  
116 to  $117^{\circ}\text{C.}$  (at 764 mm.)

Specific Gravity: 0.881(20/4)

## Uses:

synthetic apple, date, honey, melon,  
and quince flavors

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## METHYL LACTATE

## Synonyms:

lactic acid methyl ester  
methyl 2-hydroxypropanoate

Formula:  $\text{CH}_3\text{CHOHCOOCH}_3$ 

Formula Weight: 104.1

Melting Point:  $-66^{\circ}\text{C.}$

## Boiling Point:

144.8° C. (at 760 mm.)

115 to 155° C. (at 760 mm.)

## Specific Gravity:

1.118(0/4)

1.090 at 19° C.

1.08 at 16° C.

1.087 to 1.097(20/20)

9.09 lbs. per gal. at 20° C.

## Refractive Index:

1.4156 at 16° C.

1.4131

## Flash Point: 142° F. (closed)

## Heat of Combustion (gram-calories

per g.): 4778 (liquid)

## Uses:

non-grain raising stains and lacquers  
 good solvent for cellulose acetate,  
 acetobutyrate, and acetopropionate  
 and for nitrocellulose

## Solubility:

soluble in water with decomposition  
 soluble in alcohol    soluble in ether  
 miscible with most organic liquids

## METHYL LAURATE

## Synonyms:

methyl dodecanoate

lauric acid methyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{COOCH}_3$ 

## Characteristics:

no characteristic odor or flavor  
 bitter, insipid taste

Formula Weight: 214.3

Melting Point: 5° C.

## Boiling Point:

148° C. (at 18 mm.)

141° C. (at 15 mm.)

Specific Gravity: 0.874

Uses: flavor fixative

Solubility: insoluble in water

## METHYL LEVULINATE

Synonyms: levulinic acid methyl ester

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_2\text{COOCH}_3$ 

Formula Weight: 130.1

## Boiling Point:

197.7° C. (at 760 mm.)

196° C. (at 760 mm.)

191° C. (at 760 mm.)

## Specific Gravity:

1.0325

1.047(20/4)

## Uses:

solvent for cellulose acetate, and  
 starch ethers

## METHYL MALATE

## Synonyms:

dimethyl malate

malic acid (di)methyl ester

methyl hydroxysuccinate

Formula:  $\text{CH}_3\text{OOCCH}(\text{OH})\text{CH}_2\text{COOCH}_3$ 

Formula Weight: 162.1

Boiling Point: 242° C. (at 760 mm.)

Specific Gravity: 1.2226 to 1.233(20/4)

Refractive Index: 1.4425

## Solubility:

very soluble in water

∞ (in alcohol)

∞ (in ether)

## METHYL MALEATE

## Synonyms:

dimethyl maleate

maleic acid (di)methyl ester

Formula:  $\text{CH}_3\text{OOCCH}:\text{CHCOOCH}_3$ 

Formula Weight: 144.1

Melting Point: -19° C.

## Boiling Point:

205° C. (at 760 mm.)

102° C. (at 17 mm.)

## Specific Gravity:

1.151 at 21° C.

1.1606(20/4)

## Solubility:

insoluble in water    soluble in ether

## METHYL MALONATE

## Synonyms:

dimethyl malonate  
dimethyl propanedioate  
malonic acid (di)methyl ester

Formula:  $\text{CH}_2(\text{COOCH}_3)_2$ 

Formula Weight: 132.1

Melting Point:  $-62^\circ\text{C}$ .

## Boiling Point:

180 to  $181^\circ\text{C}$ . (at 760 mm.) $180.7^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.1544(20/4)

Refractive Index: 1.41490 at  $17^\circ\text{C}$ .

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## METHYL MESACONATE

## Synonyms:

dimethyl mesaconate  
mesaconic acid (di)methyl ester

Formula:  $\text{CH}_3(\text{CHCOOCH}_3)\text{CCOOCH}_3$ 

Formula Weight: 158.2

## Boiling Point:

 $205.5$  to  $206.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.121(20/20)

## METHYL METHACRYLATE

Synonyms: methacrylic acid methyl ester

Formula:  $\text{CH}_2\text{C}(\text{CH}_3)\text{COOCH}_3$ 

Formula Weight: 100.1

## Melting Point:

$-50^\circ\text{C}$ . approximately  
freezing point,  $-46^\circ\text{C}$ .

## Boiling Point:

 $100^\circ\text{C}$ . (at 760 mm.) $100$  to  $101^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.936(20/4)

 $0.938$  at  $25^\circ\text{C}$ .7.8 lbs. per gal.

Refractive Index:

1.413

1.411 at  $25^\circ\text{C}$ .Flash Point: 500 F. (open)

Uses: organic syntheses

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## Additional Data:

the commercial product contains a  
stabilizer

METHYL o-METHOXYBENZOATE

## Synonyms:

o-methoxybenzoic acid methyl ester  
methyl anisate

Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{COOCH}_3$ 

Formula Weight: 166.2

Boiling Point:  $245$  to  $246^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.157(19/4)

Solubility: soluble in alcohol

METHYL N-METHYLANTHRANILATE

## Synonyms:

N-methylantranilic acid methyl ester  
methyl methylaminobenzoate  
methylamino methylbenzoate

Formula:  $\text{CH}_3\text{NHC}_6\text{H}_4\text{COOCH}_3$ 

## Characteristics:

orange odor fainter than that of ethyl  
anthranilate  
peach flavor  
bitter-sweet to sweet taste

Formula Weight: 165.2

Melting Point:  $18$  to  $19.5^\circ\text{C}$ .Boiling Point:  $256^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 1.120 at  $15^\circ\text{C}$ .

## Uses:

shading apricot, banana, currant,  
gooseberry, honey, lemon, orange,  
peach, and plum essences

## Solubility:

insoluble in water      soluble in alcohol  
    soluble in ether

one volume dissolves:

in 10 volumes of 70% alcohol and  
 in 3 volumes of 80% alcohol

## METHYLMORPHOLINE

Formula:  $\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{NCH}_3$

Formula Weight: 101.2

Boiling Point: 115.4°C. (at 760 mm.)

Specific Gravity:

$\frac{0.916}{7.7 \text{ lbs. per gal. at } 20^\circ \text{C.}}$        $\frac{0.921(20/4)}{7.7 \text{ lbs. per gal. at } 20^\circ \text{C.}}$

Uses:

synthesis of emulsifying agent for  
 polishes

Solubility:

$\infty$  (in water)       $\infty$  (of water)

Additional Data:

azeotrope with water boils at 97°C.  
 and contains 97% methylmorpholine

## METHYL MYRISTATE

Synonyms:

methyl tetradecanoate  
 myristic acid methyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_{12}\text{COOCH}_3$

Characteristics:

weak odor similar to that of orris  
 sweet taste

Formula Weight: 242.4

Melting Point:

18.5°C.      22°C.  
 18 to 19°C.

Boiling Point: 295°C. (at 751 mm.)

Uses: synthetic honey flavors

Solubility: insoluble in water

## 1-METHYLNAPHTHALENE

Synonyms: *d*-methylnaphthalene

Formula:  $\text{C}_{10}\text{H}_7\text{CH}_3$

Characteristics: oily

Formula Weight: 142.2

Melting Point: -22°C.

Boiling Point: 240 to 243°C. (at 760 mm.)

Specific Gravity:

1.001 at 19°C.      1.028  
 1.025

8.56 lbs. per gal. at 60°F.

Refractive Index: 1.618

Uses:

diesel reference fuel  
 organic syntheses

Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether  
 soluble in most common organic  
 solvents as alcohols, ethers, esters,  
 ketones, aliphatic and aromatic  
 hydrocarbons and chlorinated  
 aliphatic and aromatic hydrocarbons

Additional Data:

6.2° API  
specific gravity of gas (air = 1.0), 4.905

## METHYLNAPHTHALENE

Synonyms:

a commercial mixture of 1- and  
 2-methylnaphthalene

Formula:  $\text{C}_{10}\text{H}_7\text{CH}_3$

Formula Weight: 142.2

Boiling Point:

240.5 to 243°C. (at 760 mm.) 90%

Specific Gravity: 8.55 lbs. per gal.

Uses:

reference fuel in standardization of  
 diesel engine fuels  
 solvent      organic syntheses

Solubility:

insoluble in water  
 soluble in most organic solvents as  
 alcohols, esters, ethers, ketones,  
 aliphatic and aromatic hydrocarbons  
 and chlorinated aliphatic and  
 aromatic hydrocarbons

## METHYL 1-NAPHTHYLACETATE

## Synonyms:

1-naphthylacetic acid methyl ester

Formula:  $C_{10}H_7CH_2COOCH_3$ 

## Characteristics:

nearly odorless

colorless to pale straw color

Formula Weight: 200.2

Boiling Point: 184 to 186°C. (at 10 mm.)

Specific Gravity: 1.141(25/25)

Refractive Index: 1.595 at 25°C.

## Solubility:

insoluble in water

∞ (in methyl alcohol)

∞ (in ether)

∞ (in carbon tetrachloride)

∞ (in benzene)

33 g. per 100 g. (in VMP naphtha)  
at 25°C.N-METHYL-1-NAPHTHYLAMINESynonyms: *d*-naphthylmethylamineFormula:  $C_{10}H_7NHCH_3$ 

## Characteristics:

red

oily

Formula Weight: 157.2

Boiling Point: 293 to 295°C. (at 760 mm.)

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

soluble in carbon disulfide

N-METHYL-2-NAPHTHYLAMINESynonyms: *β*-naphthylmethylamineFormula:  $C_{10}H_7NHCH_3$ 

Characteristics: oily

Formula Weight: 157.2

## Boiling Point:

298°C. (at 760 mm.)

308 to 310°C. (at 761 mm.)

## METHYL 1-NAPHTHYL ETHER

## Synonyms:

1-methoxynaphthalene

methyl *d*-naphthyl etherFormula:  $C_{10}H_7OCH_3$ 

Characteristics: oily

Formula Weight: 158.2

Melting Point: &lt; -10°C.

## Boiling Point:

258°C. (at 760 mm.)

265 to 269°C. (at 760 mm.)

Specific Gravity: 1.0964(13.9/4)

Refractive Index: 1.6232 at 18.0°C.

## Solubility:

insoluble in water soluble in benzene

very soluble in alcohol

very soluble in ether

## METHYL NITRATE

Formula:  $CH_3ONO_2$ 

Formula Weight: 77.0

## Boiling Point:

65°C. (at 760 mm.) explodes

## Specific Gravity:

1.217 at 15°C.

1.203 at 25°C.

1.206(20/4)

## Solubility:

slightly soluble in water

soluble in alcohol soluble in ether

METHYL o-NITROBENZOATE

## Synonyms:

o-nitrobenzoic acid methyl esterFormula:  $NO_2C_6H_4COOCH_3$ 

Characteristics: yellow

Formula Weight: 181.1

Melting Point: -8°C.

Boiling Point: 275°C. (at 760 mm.)

Specific Gravity: 1.286 at 20°C.

## Solubility:

soluble in alcohol    soluble in ether  
insoluble in petroleum ether

## 2-METHYL-2-NITROBUTANE

## Synonyms:

2-nitro-2-methylbutane  
nitropentane

Formula:  $(\text{CH}_3)_2\text{C}(\text{NO}_2)\text{C}_2\text{H}_5$

Formula Weight: 117.2

Boiling Point: 149 to 151°C. (at 748 mm.)

Specific Gravity: 0.97 at 0°C.

## 2-METHYL-4-NITROBUTANE

## Synonyms:

4-nitro-2-methylbutane  
nitropentane

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{NO}_2$

Formula Weight: 117.2

Boiling Point: 164°C. (at 756 mm.)

Specific Gravity: 0.960(20.6/4)

## 2-METHYL-2-NITROPENTANE

## Synonyms:

nitrohexane  
2-nitro-2-methylpentane

Formula:  $(\text{CH}_3)_2\text{C}(\text{NO}_2)\text{CH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 131.2

Boiling Point: 172 to 176°C. (at 756 mm.)

Specific Gravity: 0.949(0/0)

Solubility: insoluble in alkalies

## 2-METHYL-1-NITROPROPANE

## Synonyms:

*d*-isonitrobutane  
1-nitro-2-methylpropane

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{NO}_2$

Formula Weight: 103.1

Boiling Point: 158 to 159°C. (at 755 mm.)

Specific Gravity: 0.987 at 7°C.

## Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## 2-METHYL-2-NITROPROPANE

## Synonyms:

*tert*-nitrobutane  
2-nitro-2-methylpropane

Formula:  $(\text{CH}_3)_3\text{CNO}_2$

Formula Weight: 103.1

Melting Point: 24°C.

Boiling Point: 126°C. (at 748 mm.)

## Solubility:

$\infty$  (in alcohol)     $\infty$  (in benzene)  
 $\infty$  (in ether)  
insoluble in alkalies

N-METHYL-N-NITROSOANILINE

Synonyms: nitrosomethylaniline

Formula:  $\text{C}_6\text{H}_5\text{N}(\text{NO})\text{CH}_3$

## Characteristics:

yellow    oily

Formula Weight: 136.2

Melting Point: 12 to 15°C.

Boiling Point: 128°C. (at 19 mm.)

Specific Gravity: 1.124(20/4)

## Solubility:

soluble in alcohol    soluble in ether

## 2-METHYLNONANE

Synonyms: isodecane

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_6\text{CH}_3$

Formula Weight: 142.3

Melting Point: -74.7°C.

Boiling Point: 166.8°C. (at 760 mm.)

## Specific Gravity:

0.728(20/4)    0.743

Uses: organic syntheses

## 2-METHYL-1-NONANOL

Synonyms: 2-heptyl-2-methylethanol

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$ 

Formula Weight: 158.3

Boiling Point:  $118^\circ\text{C}$ . (at 15 mm.)

Specific Gravity: 0.849(0/4)

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## 7-METHYL-2,4-OCTADIENE

Synonyms: 2-methyl-4,6-octadiene

Formula:  $\text{CH}_3\text{CH}:\text{CHCH}:\text{CHCH}_2\text{CH}(\text{CH}_3)_2$ 

Formula Weight: 124.2

Boiling Point:  $149^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.752(18/4)

Solubility: insoluble in water

## 2-METHYLOCTANE

Synonyms: isononane

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_5\text{CH}_3$ 

Formula Weight: 128.3

Melting Point:  $-80.5^\circ\text{C}$ .Boiling Point:  $143.3^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.713(20/4)

d-3-METHYLOCTANE

Synonyms:

d-amylethylmethylethane  
d-nonane

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)(\text{CH}_2)_4\text{CH}_3$ 

Formula Weight: 128.3

Melting Point:  $-108^\circ\text{C}$ .

Boiling Point:

142 to  $143^\circ\text{C}$ . (at 760 mm.)  
 144.2 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.7206 at  $17^\circ\text{C}$ .

Solubility:

insoluble in water    soluble in ether  
 insoluble in alcohol

## 4-METHYLOCTANE

Synonyms: nonane

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{CH}_3)(\text{CH}_2)_3\text{CH}_3$ 

Formula Weight: 128.3

Melting Point:  $-119.3^\circ\text{C}$ .Boiling Point:  $142^\circ\text{C}$ . (at 771 mm.)

Specific Gravity: 0.725(20/4)

Solubility: insoluble in water

## 2-METHYL-2-OCTANOL

Synonyms:

dimethylhexylcarbinol  
 2-methyloctanol-2  
 nonyl alcohol

Formula:  $(\text{CH}_3)_2\text{COH}(\text{CH}_2)_5\text{CH}_3$ 

Formula Weight: 144.3

Boiling Point:  $178^\circ\text{C}$ . (at 760 mm.)

Solubility:

insoluble in water    soluble in alcohol  
                                  soluble in ether

## METHYL OLEATE

Synonyms: oleic acid methyl ester

Formula:  $\text{C}_{17}\text{H}_{33}\text{COOCH}_3$ 

Characteristics:

amber color    slight fatty odor  
 oily

Formula Weight: 296.5

Boiling Point:

216 to  $217^\circ\text{C}$ . (at 20 mm.)  
 200 to  $215^\circ\text{C}$ . (at 20 mm.)  
 189 to  $191^\circ\text{C}$ . (at 10 mm.)

Specific Gravity:

0.868 at  $28^\circ\text{C}$ .    0.789 at  $18^\circ\text{C}$ .

## Uses:

duplicating and stamping inks  
solvent for leather, resins, rubber,  
and waxes  
plasticizer for coatings, lubricants etc.

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                  $\infty$  (in ether)  
soluble in methyl alcohol, toluene,  
acetone, mineral spirits, vegetable  
oil, and ethyl acetate

Additional Data: titer,  $<0^{\circ}\text{C}$ .

## METHYL PELARGONATE

## Synonyms:

methyl nonanoate  
pelargonic acid methyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{COOCH}_3$

## Characteristics:

marked fruity odor    bitter-sweet taste  
apple flavor

Formula Weight: 172.3

## Boiling Point:

$214^{\circ}\text{C}$ . (at 760 mm.)  
 $217$  to  $214^{\circ}\text{C}$ . (at 747 mm.)

Specific Gravity: 0.877 at  $18^{\circ}\text{C}$ .

## Uses:

synthetic apple, greengage, grape,  
honey, hops, melon, mulberry,  
pineapple, and woodruff essences

## Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

## 2-METHYLPENTANE

## Synonyms:

dimethylpropyl methane  
isohexane                      hexane

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{CH}_3$

Formula Weight: 86.2

## Melting Point:

$-154^{\circ}\text{C}$ .                       $-153.7^{\circ}\text{C}$ .

## Boiling Point:

$60^{\circ}\text{C}$ . (at 760 mm.)  
 $60.3^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.654(20/4)

## Refractive Index:

1.372                      1.37145

Specific Heat (Btu. per lb. per  $^{\circ}\text{F}$ .):  
0.522 at  $80.4^{\circ}\text{F}$ .

Heat of Vaporization (Btu. per lb.):

138.32 at the boiling point

149.00 at  $77^{\circ}\text{F}$ .

## Solubility:

insoluble in water    soluble in alcohol  
                                 soluble in ether

## Additional Data:

specific gravity of gas (ideal)  
(air = 1.0), 2.9747  
specific gravity of liquid (in vacuo),  
0.65315(20/4) $^{\circ}\text{F}$ . 0.65790(60/60) $^{\circ}\text{F}$ .  
API gravity (at  $60^{\circ}\text{F}$ .), 83.6  
liquid density at  $60^{\circ}\text{F}$ . (in vacuo),  
5.4851  
aniline point (critical solution  
temperature),  $165.0^{\circ}\text{F}$ .  
coefficient of expansion,  
0.00082 at 68 to  $86^{\circ}\text{F}$ .  
total heating values (at  $77^{\circ}\text{F}$ .),  
20,743 Btu./lb.,  
112,260 Btu./cu. ft.-gas

## 3-METHYLPENTANE

## Synonyms:

diethylmethylethane  
hexane

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

Formula Weight: 86.2

Melting Point:  $-118^{\circ}\text{C}$ .

## Boiling Point:

$64^{\circ}\text{C}$ . (at 760 mm.)  
 $63.2^{\circ}\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.676(20/4)                      0.673  
0.664(20/4)

## Refractive Index:

1.37652                      1.37662

## 3-METHYLPENTANE (Cont.)

Specific Heat (Btu. per lb. per ° F.):  
0.551 at 80.4° F.

Heat of Vaporization (Btu. per lb.):  
141.07 at the boiling point  
151.03 at 77° F.

Uses: organic syntheses

## Solubility:

insoluble in water ∞ (in alcohol)  
soluble in ether

## Additional Data:

specific gravity of gas (ideal)  
(air = 1.0), 2.9749  
specific gravity of liquid (in vacuo),  
0.66433(20/4)° C. 0.66902(60/60)° F.  
API gravity (at 60° F.), 80.0  
liquid density (in vacuo),  
5.5778 at 60° F.  
aniline point (critical solution  
temperature), 156.7° F.  
critical temperature, 441° F.  
critical pressure, 469 psia.  
coefficient of expansion,  
0.00076 at 60 to 77° F.  
total heating values (at 77° F.),  
20,755 Btu./lb.,  
114,270 Btu./cu. ft.-gas

## 2-METHYL-1,3-PENTANEDIOL

Formula:  $C_2H_5CHOHCH(CH_3)CH_2OH$

## Characteristics:

pleasant typical glycol odor

Boiling Point: 215° C. (at 760 mm.)

Specific Gravity: 0.9734(20/20)

Refractive Index: 1.4456

## Viscosity (centipoises):

468 at 15° C. 85 at 35° C.  
182 at 25° C.

Flash Point: 230° F. (open)

## Uses:

organic syntheses  
useful coupling compound for dry  
cleaning soaps, emulsions,  
lubricating compounds, and

soluble oils  
coating formulations  
surface active agents  
printing inks alkyd resins

## Solubility:

250 cc. to 100 cc. (of water)  
10 cc. to 100 cc. (in water)  
0.5% by weight (in petroleum ether)  
at 20 to 40° C.  
∞ (in carbon tetrachloride)  
∞ (in methyl alcohol)  
∞ (in dichlorobenzene)  
∞ (in alcohol) ∞ (in acetone)  
∞ (in ether) ∞ (in benzene)  
0.5% (in pentane)  
0.5% (in cyclohexane)  
soluble in most common organic  
solvents

## Additional Data:

avoid prolonged breathing, contact  
with skin or ingestion  
pour point, -4° C.

## 2-METHYL-2,4-PENTANEDIOL

## Synonyms:

hexylene glycol  
methyl 2,4-pentandiol(2)  
*a, a, a'*-trimethyltrimethylene glycol

Formula:  $(CH_3)_2COHCH_2CHOHCH_3$

Formula Weight: 118.2

Melting Point: -100° C.

## Boiling Point:

196 to 197.8° C. (at 760 mm.)  
195 to 199° C. (at 760 mm.)  
122.5° C. (at 50 mm.)  
96 to 98° C. (at 10 mm.)

## Specific Gravity:

0.9240(17/4) 0.922(20/20)  
0.9217(20/4)  
7.68 lbs. per gal. at 20° C.

Refractive Index: 1.4274

## Vapor Pressure (mm. Hg):

0.02 at 20° C. 334 at 169.7° C.  
10.8 at 95.2° C.

Flash Point: 205° F. (open)

Heat of Vaporization (gram-calories per g.): 164

Uses:

hydraulic brake fluids  
mutual solvent or coupling agent for otherwise immiscible liquids  
manufacture of cutting oils and metal cleaning compositions  
substitute for glycerol as a penetrant for pastes used in textile color printing

Solubility:

very soluble in alcohol, ether, and carbon tetrachloride  
miscible with water in all proportions  
completely miscible with alcohols, ketones, aromatic and petroleum hydrocarbons, and castor oil

Additional Data:

has mild humectant properties

### 2-METHYL-1-PENTANOL

Synonyms:

2-methylpentanol-1  
2-methyl-2-propylethanol

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$

Formula Weight: 102.2

Boiling Point: 148° C. (at 760 mm.)

Specific Gravity:

0.826(20/4)      0.831(15.6/15.6)

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)

### 3-METHYL-1-PENTANOL

Synonyms:

active hexyl alcohol  
3-methylpentanol-1

Formula:  $\text{C}_2\text{H}_5(\text{CH}_3)\text{CHCH}_2\text{CH}_2\text{OH}$

Formula Weight: 102.2

Boiling Point:

152 to 154.1° C. (at 760 mm.)

Specific Gravity:

0.8262 at 20° C.      0.8205(25/4)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

### 4-METHYL-1-PENTANOL

Synonyms:

isoamylcarbinol  
4-methylpentanol-1  
2-methylpentanol-5

Formula:  $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{CH}_2\text{OH}$

Formula Weight: 102.2

Boiling Point:

147 to 148° C. (at 760 mm.)  
151.8 to 152.8° C. (at 760 mm.)

Specific Gravity:

0.8243 at 0° C.      0.8156(20/4)

Refractive Index: 1.4490

Solubility:

very slightly soluble in water  
very soluble in alcohol and ether

### 2-METHYL-2-PENTANOL

Synonyms:

dimethylpropylcarbinol  
2-methylpentanol-2

Formula:  $(\text{CH}_3)_2\text{COH}(\text{CH}_2)_2\text{CH}_3$

Formula Weight: 102.2

Melting Point: -103° C.

Boiling Point:

121.1 to 123.5° C. (at 760 mm.)

Solubility:

very slightly soluble in water  
very soluble in alcohol  
 $\infty$  (in ether)

### 3-METHYL-2-PENTANOL

Synonyms: 3-methylpentanol-2

Formula:  $\text{CH}_3\text{CHOHCH}(\text{CH}_3)\text{C}_2\text{H}_5$

Characteristics: oily

Formula Weight: 102.2

Boiling Point: 135° C. (at 762 mm.)

Specific Gravity: 0.831(18/4)

## 4-METHYL-2-PENTANOL

### 4-METHYL-2-PENTANOL

#### Synonyms:

isobutylmethylcarbinol  
methylisobutylcarbinol  
2-methylpentanol-4  
4-methylpentanol-2

Formula:  $(CH_3)_2CHCH_2CHOHCH_3$

Characteristics: pleasant odor

Formula Weight: 102.2

#### Boiling Point:

131.4 to 131.8° C. (at 760 mm.)

#### Specific Gravity:

0.8065 to 0.813(20/4)

0.8079(20/20)

6.73 lbs. per gal. at 20° C.

Refractive Index: 1.409 to 1.4113

Surface Tension (in dynes per cm.):

22.8 at 20° C.

#### Flash Point:

106° F. (closed) 131° F. (open)

Heat of Vaporization (gram-calories per g.): 104.0

#### Uses:

solvent for dyes, gums, oils, resins,  
and waxes  
frother for ore flotation  
germicides organic syntheses  
lacquers  
in nitrocellulose lacquers as a latent  
solvent, as an additive to ketones to  
modify evaporation rate and increase  
blush resistance  
in miscellaneous coating compositions  
containing ethyl cellulose, alkyds,  
phenolic resins, etc.  
preparation of photographic reagents  
industrial cleaning compounds  
pharmaceuticals fine chemicals

Solubility (grams per 100 ml.):

5.8 at 20° C. (of water)

1.6 at 20° C. (in water)

∞ (in alcohol) ∞ (in ether)

#### Additional Data:

composition of the two phase system  
4-methyl-2-pentanol - water at 20° C

	Weight % Alcohol	Weight % Water
Upper Layer	93.7	6.3
Lower Layer	1.8	98.2

coefficient of expansion,

0.000565 per ° F.

rate of evaporation

(n-butyl acetate 1.0), 0.3

azeotropic mixture with water contains

55.8% by weight of this alcohol and

boils at 94.3° C.

the toxicity of this alcohol is about

same as that of n-butyl alcohol

### 4-METHYL-2-PENTANOL ACETATE

#### Synonyms:

1,3- or α, γ-dimethylbutyl acetate  
methylisobutylcarbinol acetate  
4-methylpentyl acetate-2

Formula:  $CH_3COOCH(CH_3)CH_2CH(CH_3)_2$

Characteristics: mild, agreeable odor

Formula Weight: 144.2

Boiling Point: 146° C. (at 760 mm.)

#### Specific Gravity:

0.8595(20/20) 0.8580(20/4)

7.1 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg): 3.8 at 20° C

Flash Point: 110° F. (open)

#### Uses:

high boiling point solvent for nitro-  
cellulose, lacquers, and thinners

Solubility (grams per 100 ml.):

0.58 at 20° C. (of water)

0.082 at 25° C. (in water)

0.13 at 20° C. (in water)

#### Additional Data:

this solvent has high blush resistance

## 4-METHYL-2-PENTANOL BUTYRATE

Synonyms: *d*-methylisoamyl butyrateFormula:  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{OCC}_3\text{H}_7)\text{CH}_3$ 

Formula Weight: 172.3

Melting Point:  $-48^\circ\text{C}$ .Boiling Point:  $183^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.853

Solubility (grams per 100 ml.):

0.8 at  $35^\circ\text{C}$ . (in water)

## 2-METHYL-3-PENTANOL

Synonyms:

ethylisopropylcarbinol

2-methylpentanol-3

Formula:  $(\text{CH}_3)_2\text{CHCHOHC}_2\text{H}_5$ 

Formula Weight: 102.2

Boiling Point:  $127.5^\circ\text{C}$ . (at 721 mm.)

Specific Gravity: 0.826(18/4)

Solubility:

very slightly soluble in water

 $\infty$  (in alcohol)  $\infty$  (in ether)

## 3-METHYL-3-PENTANOL

Synonyms:

diethyl methylcarbinol

3-methylpentanol-3

Formula:  $\text{C}_2\text{H}_5\text{COH}(\text{CH}_3)\text{C}_2\text{H}_5$ 

Formula Weight: 102.2

Melting Point:

 $-22^\circ\text{C}$ .  $< -28^\circ\text{C}$ .

Boiling Point:

 $122.8$  to  $123.0^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.824(20/0) 0.8233(25/4)

Refractive Index: 1.4196

Solubility:

slightly soluble in water

 $\infty$  (in alcohol)  $\infty$  (in ether)

## 3-METHYL-2-PENTANONE

Synonyms:

*sec*-butyl methyl ketone*asym.*-ethylmethylacetone

3-methylpentanone-2

Formula:  $\text{CH}_3\text{COCH}(\text{CH}_3)\text{C}_2\text{H}_5$ 

Formula Weight: 100.2

Boiling Point:

 $117.8$  to  $118.0^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.818(14/4) 0.815(18/4)

Solubility:

slightly soluble in water

 $\infty$  (in alcohol)  $\infty$  (in ether)

## 4-METHYL-2-PENTANONE

Synonyms:

hexone

isobutyl methyl ketone

2-methylpentanone-4

4-methylpentanone-2

Formula:  $\text{CH}_3\text{COCH}_2\text{CH}(\text{CH}_3)_2$ 

Characteristics:

pleasant, typical ketone odor

Formula Weight: 100.2

Melting Point:  $-84.7$  to  $-83.5^\circ\text{C}$ .

Boiling Point:

 $115$  to  $118^\circ\text{C}$ . (at 760 mm.) $119^\circ\text{C}$ . (at 760 mm.) $112$  to  $118^\circ\text{C}$ . (at 760 mm.) $114$  to  $117^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.800 to 0.8024(20/20)

0.8004 to 0.8017(20/4)

6.7 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.3958

Surface Tension (dynes per cm.):

25.4 at  $25^\circ\text{C}$ .Viscosity (poises): 0.0056 at  $25^\circ\text{C}$ .

Flash Point:

 $64^\circ\text{F}$ . (closed) $81^\circ\text{F}$ . (open)

## 4-METHYL-2-PENTANONE (Cont.)

Specific Heat (gram-calories per g. per °C.): 0.46 at 20°C. (liquid)

Heat of Vaporization (gram-calories per g.): 87.0

## Uses:

medium boiling solvent for benzyl and ethyl cellulose, camphor, fats, gums, lacquers, nitrocellulose, resins, synthetic resin finishes, polymerized vinyl resins, and waxes

latent solvent for cellulose acetate solvent mixtures      denaturant for dewaxing oils      alcohol paint removers

## Solubility (grams per 100 ml.)

1.9 at 25°C. (of water)

1.7 at 25°C. (in water)

2.0 at 20°C. (in water)

∞ (in alcohol)

∞ (in ether)

∞ (in benzene)

miscible in all proportions with most organic solvents

## Additional Data:

vapor density, 3.45

coefficient of expansion,  
0.000625 per °F.

0.00122 at 10 to 30°C.

azeotropic mixture with water boils at 87.9°C. and contains 75.7 weight % of 4-methyl-2-pentanone

dilution ratios,

with toluene, 3.9

with high aromatic petroleum diluent, 2.0

## 2-METHYL-3-PENTANONE

## Synonyms:

ethyl isopropyl ketone

2-methylpentanone-3

Formula:  $C_2H_5COCH(CH_3)_2$

Formula Weight: 100.2

Boiling Point: 114°C. (at 745 mm.)

Specific Gravity:

0.830 at 0°C.      0.814(18/0)

## Solubility:

very slightly soluble in water

very soluble in alcohol

∞ (in ether)

## 2-METHYL-1-PENTENE

## Synonyms:

hexylene

2-methylpentene-1

1-methyl-1-propylethylene

Formula:  $CH_2:C(CH_3)CH_2CH_2CH_3$

Formula Weight: 84.2

Boiling Point:

61.5 to 62.0°C. (at 760 mm.)

Specific Gravity: 0.6817

## 3-METHYL-1-PENTENE

## Synonyms:

sec-butylethylene      hexylene

3-methylpentene-1

Formula:  $CH_2:CHCH(CH_3)C_2H_5$

Formula Weight: 84.2

Boiling Point:

53.6 to 54.0°C. (at 760 mm.)

Specific Gravity: 0.6700

## 4-METHYL-1-PENTENE

## Synonyms:

hexylene

isobutylethylene

4-methylpentene-1

Formula:  $CH_2:CHCH_2CH(CH_3)_2$

Formula Weight: 84.2

Boiling Point:

53.6 to 53.9°C. (at 760 mm.)

Specific Gravity: 0.6646

## 2-METHYL-2-PENTENE

## Synonyms:

2-ethyl-1,1-dimethylethylene

hexylene

2-methylpentene-2

Formula:  $(CH_3)_2C:CHCH_2CH_3$

Formula Weight: 84.2

Boiling Point:

67.2 to 67.5° C. (at 760 mm.)

Specific Gravity:

0.6904                      0.690(20/4)

Solubility:

soluble in a mixture of  
2 volumes of sulfuric acid and  
1 volume of water

### 3-METHYL-2-PENTENE

Synonyms:

1-ethyl-1,2-dimethylethylene  
hexylene  
3-methylpentene-2

Formula:  $\text{CH}_3\text{CH}:\text{C}(\text{CH}_3)\text{C}_2\text{H}_5$

Formula Weight: 84.2

Boiling Point:

isomer I: 67.6 to 68.2° C. (at 760 mm.)  
isomer II: 65.7 to 66.2° C. (at 760 mm.)

Specific Gravity:

isomer I: 0.6956  
isomer II: 0.6940

### 4-METHYL-2-PENTENE

Synonyms:

hexylene  
1-isopropyl-2-methylethylene  
4-methylpentene-2

Formula:  $\text{CH}_3\text{CH}:\text{CHCH}(\text{CH}_3)_2$

Formula Weight: 84.2

Boiling Point:

isomer I: 57.5 to 58.5° C. (at 760 mm.)  
isomer II: 54.2 to 55.2° C. (at 760 mm.)

Specific Gravity:

isomer I: 0.6709  
isomer II: 0.6702

### *d, d*-METHYLPHENYLHYDRAZINE

Formula:  $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)\text{NH}_2$

Characteristics: yellow

Formula Weight: 122.2

Boiling Point: 131° C. (at 35 mm.)

Specific Gravity: 1.038(21.6/4)

Solubility:

slightly soluble in hot water  
 $\infty$  (in alcohol)                       $\infty$  (in chloroform)  
 $\infty$  (in ether)                       $\infty$  (in benzene)

### *d, \beta*-METHYLPHENYLHYDRAZINE

Formula:  $\text{C}_6\text{H}_5\text{NHNHCH}_3$

Characteristics: oily

Formula Weight: 122.2

Boiling Point:

110 to 112° C. (at 12 to 15 mm.)

Specific Gravity: 1.04(15/15)

Solubility:

soluble in alcohol and ether

### (3-METHYLPHENYL)- PHENYLTHIAMETHANE

Formula:  $\text{C}_{13}\text{H}_{12}\text{S}$

Formula Weight: 200.1

Melting Point: -7° C.

Boiling Point:

310° C. (at 760 mm.)  
226° C. (at 100 mm.)  
161° C. (at 10 mm.)

Specific Gravity:

1.090 at 20° C.                      1.086 at 25° C.

### (4-METHYLPHENYL)- PHENYLTHIAMETHANE

Formula:  $\text{C}_{13}\text{H}_{12}\text{S}$

Formula Weight: 200.1

Melting Point: 16° C.

Boiling Point:

321° C. (at 760 mm.)  
229° C. (at 100 mm.)  
164° C. (at 10 mm.)

Specific Gravity: 1.087 at 20° C.

## METHYL PHOSPHATE

Synonyms: trimethyl phosphate

Formula:  $(\text{CH}_3)_3\text{PO}_4$

Formula Weight: 140.1

Boiling Point:

193 to 197.2° C. (at 760 mm.)

67 to 68° C. (at 7 mm.)

Specific Gravity:

1.220 at 15° C.

1.197(19.5/0)

Uses:

methyating agent    oil addition agent  
possible component of hydraulic fluid

Additional Data:

methyl phosphate is slightly hydrolyzed  
by water

## METHYLPHOSPHORIC ACID

Characteristics: pale straw color

Specific Gravity: 1.42 at 25° C.

Uses:

catalyst in urea resin formation  
textile and paper processing  
polymerizing agent for oils and resins

Solubility: soluble in water

Additional Data:

contains some orthophosphoric acid  
and some methanol  
very hygroscopic  
alkyl acid content: approximately 97%

## 1-METHYLPIPERIDINE

Formula:  $\text{C}_5\text{H}_{10}\text{NCH}_3$

Formula Weight: 99.2

Boiling Point: 105.9° C. (at 760 mm.)

Specific Gravity: 0.8207 at 20° C.

Refractive Index: 1.4378

Solubility (grams per 100 ml.):

14.8 at 49° C. (in water)

5.5 at 77° C. (in water)

∞ (in alcohol)

∞ (in ether)

## METHYL PIVALATE

Synonyms:

methyl trimethylacetate  
pivalic acid methyl ester

Formula:  $(\text{CH}_3)_3\text{CCOOCH}_3$

Formula Weight: 116.2

Boiling Point: 100 to 102° C. (at 760 mm.)

Specific Gravity:

0.891(0/4)

1.044 at 0° C.

Solubility:

slightly soluble in water  
∞ (in alcohol)    ∞ (in ether)

## 2-METHYL-1,2-PROPANEDIOL

Synonyms:

asym-dimethylethylene glycol  
isobutylene glycol  
2-methylpropanediol-1,2

Formula:  $(\text{CH}_3)_2\text{COHCH}_2\text{OH}$

Formula Weight: 90.1

Boiling Point:

177 to 178.6° C. (at 760 mm.)

Specific Gravity:

1.003

0.994(20/4)

Solubility: very soluble in water

## 2-METHYL-1-PROPANETHIOL

Synonyms:

isobutyl mercaptan  
2-methylpropanethiol-1

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{SH}$

Formula Weight: 90.2

Melting Point: < -79° C.

Boiling Point: 88° C. (at 760 mm.)

Specific Gravity: 0.8357(20/4)

Refractive Index: 1.43859

Solubility:

slightly soluble in water  
soluble in alcohol    soluble in ether

## 2-METHYL-2-PROPANETHIOL

Synonyms: tert-butyl mercaptanFormula:  $(\text{CH}_3)_3\text{CSH}$ 

Characteristics: mercaptan odor

Formula Weight: 90.2

Freezing Point:  $-2^\circ\text{C}$ .

Boiling Point:

65 to  $67^\circ\text{C}$ . (at 760 mm.)62 to  $69^\circ\text{C}$ . (at 760 mm.)Specific Gravity: 0.803(20/20)Refractive Index: 1.424Viscosity (centipoises): 0.68 at  $20^\circ\text{C}$ .Flash Point:  $<-20^\circ\text{F}$ . (closed)

Solubility:

insoluble in water

soluble in methanol, ether, acetone,  
benzene, gasoline, and ethyl acetate

## 2-METHYL-2-PROPEN-1-OL

Synonyms:

isobutenol                      methallyl alcohol

isopropenyl carbinol

Formula:  $\text{CH}_2\text{C}(\text{CH}_3)\text{CH}_2\text{OH}$ 

Formula Weight: 72.1

Boiling Point:

114.5 $^\circ\text{C}$ . (at 760 mm.)109 to 116 $^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure (mm. Hg):

6.6 at  $20^\circ\text{C}$ .                      24.4 at  $40^\circ\text{C}$ .12.8 at  $30^\circ\text{C}$ .

Specific Gravity:

0.8515(20/4)

0.853 to 0.856(20/20)

7.11 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4255

Flash Point:

92 $^\circ\text{F}$ . (closed)                      94 $^\circ\text{F}$ . (open)Heat of Vaporization (gram-calories  
per g.): 141.0

Uses: organic syntheses

Solubility (grams per 100 ml.):

25.4 (of water)                       $\infty$  (in alcohol)19.4 (in water)                       $\infty$  (in ether)

Additional Data:

azeotrope with water boils at  $92.5^\circ\text{C}$ .  
and contains 59.6% by weight of the  
alcohol

Composition in the Two-Phase System

2-methyl-2-propen-1-ol -

Water at  $20^\circ\text{C}$ .

	Weight % Alcohol	Weight % Water
Lower Layer	16.9	83.1
Upper Layer	74.8	25.2

## METHYL PROPIONATE

Synonyms:

methyl propanoate

propionic acid methyl ester

Formula:  $\text{CH}_3\text{CH}_2\text{COOCH}_3$ 

Characteristics:

fresh fruity odor                      sweet taste  
flavor of black currant

Formula Weight: 88.1

Melting Point:  $-87.5^\circ\text{C}$ .

Boiling Point:

79.9 $^\circ\text{C}$ . (at 760 mm.)78 to 79.5 $^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.9148(20/4)

0.937 at  $4^\circ\text{C}$ .7.58 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:

1.37767 at  $18.5^\circ\text{C}$ .    1.3769 at  $20^\circ\text{C}$ .Flash Point: 28 $^\circ\text{F}$ . (closed)

Uses:

solvent for cellulose nitrate  
solvent mixtures for cellulose  
derivativescoatings, lacquers, paints, and  
varnishes

synthetic black currant flavors

Solubility (grams per 100 ml.):

6.5 at  $20^\circ\text{C}$ . (in water) $\infty$  (in alcohol)                       $\infty$  (in ether)

miscible with most organic solvents

## METHYL PROPIONATE (Cont.)

## Additional Data:

vapor density, 3.03

critical temperature, 257.4° C.

critical pressure, 39.3 atm.

N-METHYLPROPYLAMINEFormula:  $\text{CH}_3\text{NHCH}_2\text{CH}_2\text{CH}_3$ 

Formula Weight: 73.1

Boiling Point: 62 to 64° C. (at 760 mm.)

Specific Gravity: 0.720 at 17° C.

## Solubility:

soluble in water and alcohol

## METHYL PROPYL ETHER

Synonyms: 1-methoxypropane

Formula:  $\text{CH}_3\text{OCH}_2\text{C}_2\text{H}_5$ 

Formula Weight: 74.1

Boiling Point: 38.9 to 40° C. (at 760 mm.)

Specific Gravity: 0.738(20/4)

Refractive Index: 1.3579

Solubility (grams per 100 ml.):

3.05 at 25° C. (in water)

 $\infty$  (in alcohol)  $\infty$  (in ether)

## METHYL 2-PROPYNYL ETHER

Synonyms: methyl propargyl ether

Formula:  $\text{CH}_3\text{OCH}_2\text{C}\equiv\text{CH}$ 

Formula Weight: 70.1

Boiling Point: 61 to 62° C. (at 760 mm.)

Specific Gravity: 0.83 at 12.5° C.

## Solubility:

very slightly soluble in water

 $\infty$  (in alcohol)  $\infty$  (in ether)

## 1-METHYLPYRROLE

Synonyms: N-methylpyrroleFormula:  $\text{N}(\text{CH}_3)\text{CH}:\text{CHCH}:\text{CH}$ 

Formula Weight: 81.1

Boiling Point: 114 to 115° C. (at 748 mm.)

Specific Gravity: 0.9203 at 10° C.

Refractive Index: 1.4888 at 16° C.

## Solubility:

insoluble in water  $\infty$  (in alcohol) $\infty$  (in ether)

## 2-METHYLPYRROLE

Synonyms: *d*-methylpyrroleFormula:  $\text{NCH}(\text{CH}_3):\text{CHCH}:\text{CH}$ 

Formula Weight: 81.1

## Boiling Point:

148° C. (at 760 mm.)

147 to 148° C. (at 750 mm.)

Specific Gravity: 0.945

## Solubility:

insoluble in water  $\infty$  (in alcohol) $\infty$  (in ether)

## 3-METHYLPYRROLE

Synonyms:  $\beta$ -methylpyrroleFormula:  $\text{NCH}:\text{CH}(\text{CH}_3)\text{CH}:\text{CH}$ 

Formula Weight: 81.1

## Boiling Point:

143° C. (at 760 mm.)

142 to 143° C. (at 743 mm.)

## Solubility:

slightly soluble in dilute acids

## 1-METHYLPYRROLIDINE

## Synonyms:

N-methylpyrrolidineN-methylpyrrolineFormula:  $\text{CH}_3\text{NC}_4\text{H}_6$ 

Formula Weight: 85.2

## Boiling Point:

79 to 80° C. (at 760 mm.)

81 to 83° C. (at 760 mm.)



## METHYL SALICYLATE (Cont.)

## Melting Point:

-8.6° C. 1.2° C.

Boiling Point: 222 to 223° C. (at 760 mm.)

## Specific Gravity:

1.182(25/25) 1.1840(20.2/4)  
9.95 lbs. per gal. at 25° C.

Refractive Index: 1.5369

## Flash Point:

214° F. (closed) 225° F. (open)

## Uses:

synthetic wintergreen extract  
 synthetic apricot, birch, beer, black-  
 berry, cranberry, currant, grape,  
 gooseberry, huckleberry, mulberry,  
 peach, raspberry, root beer,  
 sarsaparilla, strawberry, and tea  
 flavors  
 coatings, inks, insecticides, odorants,  
 perfumes, polishes, gargles, etc.  
 solvent for cellulose derivatives  
 organic syntheses

## Solubility (grams per 100 ml.):

0.074 at 30° C. (in water)  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
 soluble in carbon disulfide chloroform  
 soluble in glacial acetic acid

## Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
60	1:20
70	1:8
90	1:1

## Additional Data:

autoignition temperature, 850° F.  
 vapor density, 5.24

## 2-METHYL SALIGENIN ETHER

## Synonyms:

o-methoxybenzyl alcohol  
 saligenin 2-methyl ether

Formula:  $\text{CH}_3\text{OC}_6\text{H}_4\text{CH}_2\text{OH}$ 

Formula Weight: 138.2

Boiling Point: 248 to 250° C. (at 760 mm.)

Specific Gravity: 1.043(25/25)

## Solubility:

very slightly soluble in water  
 soluble in alcohol  $\infty$  (in ether)

## METHYL SEBACATE

## Synonyms:

dimethyl sebacate  
 sebacic acid (di) methyl ester

Formula:  $[(\text{CH}_2)_2\text{COOCH}_3]_2$ 

Formula Weight: 230.3

## Melting Point:

26° C. 24.5° C.

## Boiling Point:

293° C. (at 754 mm.)  
294° C. (at 760 mm.)

## Specific Gravity:

0.9896(25/20) 0.988(28/4)

Refractive Index: 1.4376

## Uses:

solvent and plasticizer for nitro-  
 celluloses and vinyls

## METHYL SELENIDE

## Synonyms:

dimethyl selenide selenium methyl

Formula:  $(\text{CH}_3)_2\text{Se}$ 

Formula Weight: 109.0

Boiling Point: 58.2° C. (at 760 mm.)

Specific Gravity: 1.4077(14.6/4)

## Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

*d*-METHYLSTYRENE

## Synonyms:

isopropenylbenzene  
uns-methylphenyl ethylene  
 $\beta$ - or 2-phenylpropene

Formula:  $\text{CH}_3\text{C}(\text{C}_6\text{H}_5):\text{CH}_2$ 

## Characteristics:

odor resembles that of styrene

Formula Weight: 118.2

Melting Point:

< -20° C.                      -23.2° C.

Boiling Point:

165° C. (at 764 mm.)

165 to 169° C. (at 760 mm.)

Specific Gravity:

0.91939(20/4)                      0.9062 at 25° C.

0.910 to 0.914(25/25)

Refractive Index: 1.5359 at 25° C.

Flash Point: 118° F. (closed)

Uses:

organic synthesis of various  
copolymers

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

∞ (in acetone)                      ∞ (in benzene)

∞ (in carbon tetrachloride)

completely miscible with methanol and  
most other organic solvents

Additional Data: fire point, 134.6° F.

### METHYL SUCCINATE

Synonyms:

dimethyl butanedioate

dimethyl succinate

succinic acid (di) methyl ester

Formula:  $\text{CH}_3\text{OOC}(\text{CH}_2)_2\text{COOCH}_3$

Formula Weight: 146.1

Melting Point: 19.5° C.

Boiling Point:

192.8 to 195.3° C. (at 760 mm.)

Specific Gravity:

1.1202(18/4)                      1.126(15/15)

Refractive Index: 1.41796

Solubility (grams per 100 ml.):

2.8 (in water)                      soluble in alcohol

### METHYL SULFATE

Synonyms: dimethyl sulfate

Formula:  $(\text{CH}_3\text{O})_2\text{SO}_2$

Characteristics: oily

Formula Weight: 126.1

Freezing Point:

-31.8 to -27° C.                      -10° C.

Boiling Point:

188.3 to 188.6° C. (at 760 mm.)

76° C. (at 15 mm.)

Specific Gravity:

1.3322(20/4)                      1.352(0/4)

Refractive Index: 1.3874

Flash Point:

182° F. (closed)                      240° F. (open)

Uses:

organic syntheses (methylation of  
amines, phenols, etc.)

Solubility:

very slightly soluble in water

∞ (in alcohol)                      ∞ (in benzene)

∞ (in ether)

Additional Data:

toxic

vapor density, 4.35

### METHYL SULFIDE

Synonyms:

dimethyl sulfide

methanethiomethane

methylthiomethane

Formula:  $(\text{CH}_3)_2\text{S}$

Characteristics:

disagreeable odor                      oily

Formula Weight: 62.1

Melting Point: -83.2° C.

Boiling Point:

36.0 to 38.0° C. (at 760 mm.)

Specific Gravity: 0.8458(21/4)

Uses: organic syntheses

Solubility:

insoluble in water                      soluble in alcohol  
soluble in ether

## METHYL SULFIDE (Cont.)

## Additional Data:

critical temperature, 229.9° C.

critical pressure, 54.6 atm.

## METHYL SULFITE

Synonyms: dimethyl sulfite

Formula:  $(\text{CH}_3\text{O})_2\text{SO}$ 

Formula Weight: 110.1

## Boiling Point:

122° C. (at 760 mm.)

126.5° C. (at 756 mm.)

## Specific Gravity:

1.242(0/0)

1.046(16.2/4.1)

## Solubility:

decomposes in water

soluble in alcohol    soluble in ether

## METHYL SULFOXIDE

## Synonyms:

dimethyl sulfoxide

methylsulfinylmethane

Formula:  $\text{CH}_3\text{SOCH}_3$ 

## Characteristics:

oily

syropy

Formula Weight: 78.1

Melting Point: 6° C.

Boiling Point: decomposes at 100° C.

## Solubility:

very soluble in water

very soluble in alcohol

very soluble in ether

## METHYLSULFURIC ACID

## Synonyms:

acid methyl sulfate

hydrogen methyl sulfate

methyl hydrogen sulfate

Formula:  $\text{CH}_3\text{OSO}_2\text{OH}$ 

Characteristics: oily

Formula Weight: 112.1

Melting Point: &lt;-30° C.

## Boiling Point:

decomposes at 130 to 140° C.

## Uses:

organic syntheses    vat dyes

## Solubility:

very soluble in water

soluble in alcohol

 $\infty$  (in absolute ether)

## METHYL TELLURIDE

## Synonyms:

dimethyl telluride    tellurium methyl

Formula:  $(\text{CH}_3)_2\text{Te}$ 

## Characteristics:

yellow

oily

Formula Weight: 157.7

Boiling Point: 82° C. (at 760 mm.)

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## METHYL TETRAMETHYL GLUCOSIDE

Formula:  $(\text{CH}_3\text{O})_5\text{C}_6\text{H}_7\text{O}$ 

Formula Weight: 250.3

Boiling Point: 145 to 150° C. (at 13 mm.)

Specific Gravity: 1.108 at 20° C.

## Solubility:

slightly soluble in water

slightly soluble in ether

soluble in alcohol

soluble in chloroform

1-(1-METHYL-2-THIACYCLOPROPYL)-  
4-METHYL-3-CYCLOHEXENEFormula:  $\text{C}_{10}\text{H}_{16}\text{S}$ 

Formula Weight: 168.1

Melting Point: -27° C.

Boiling Point: 105° C. (at 760 mm.)

Specific Gravity: 0.997 at 25° C.

Refractive Index: 1.517 at 25° C.

## 4-METHYL-1,4-THIAZANE

Characteristics: oily

Boiling Point: 163 to 164° C. (at 757 mm.)

Specific Gravity: 0.9959 at 15° C.

Uses: organic syntheses

## METHYL THIOCYANATE

Synonyms:

methyl sulfocyanate

thiocyanic acid methyl ester

Formula:  $\text{CH}_3\text{SCN}$

Formula Weight: 73.1

Melting Point: -51° C.

Boiling Point: 130 to 133° C. (at 760 mm.)

Specific Gravity:

1.068                      1.069(24/4)

Refractive Index: 1.46801 at 23.5° C.

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)

## 2-METHYLTHIOPHENE

Synonyms: *o*-thiotoluene

Formula:  $\text{CH}_3\text{C}_4\text{H}_3\text{S}$

Formula Weight: 98.2

Melting Point: -66 to -63° C.

Boiling Point:

112 to 115° C. (at 760 mm.)

112 to 113° C. (at 760 mm.)

Specific Gravity: 1.019(20/4)

Refractive Index: 1.5202 to 1.5209

Absolute Viscosity (centipoises):

0.716 at 20° C.

Uses: organic syntheses

Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

Additional Data:

molecular refraction, 29.29 at 20° C.

## 3-METHYLTHIOPHENE

Synonyms:

*β*-methylthiotoluene

*β*-thiotoluene

Formula:  $\text{CH}_3\text{C}_4\text{H}_3\text{S}$

Characteristics: oily

Formula Weight: 98.2

Melting Point:

-68.9° C.

-70 to -68° C.

Boiling Point:

114° C. (at 738 mm.)

115 to 116° C. (at 760 mm.)

Specific Gravity:

1.0247(15.8/4)

1.022(20/4)

Refractive Index: 1.5203 to 1.5209

Absolute Viscosity (centipoises):

0.687 at 20° C.

Uses: organic syntheses

Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

Additional Data:

molecular refraction, 29.23 at 20° C.

METHYL m-TOLUATE

Synonyms: m-toluic acid methyl ester

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{COOCH}_3$

Formula Weight: 150.2

Melting Point: < -50° C.

Boiling Point: 215° C. (at 760 mm.)

Specific Gravity: 1.066 at 15° C.

Solubility: insoluble in water

METHYL o-TOLUATE

Synonyms: o-toluic acid methyl ester

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{COOCH}_3$

Formula Weight: 150.2

Boiling Point: 213° C. (at 760 mm.)

METHYL o - TOLUATE (Cont.)

Specific Gravity: 1.073 at 15° C.

Solubility:

insoluble in water    ∞ (in alcohol)  
                                  ∞ (in ether)

N-METHYL-m-TOLUIDINEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NHCH}_3$ 

Formula Weight: 121.2

Boiling Point: 206 to 207° C. (at 760 mm.)

Refractive Index: 1.5649

Solubility:

insoluble in water    ∞ (in alcohol)  
                                  ∞ (in ether)

N-METHYL o-TOLUIDINEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NHCH}_3$ 

Formula Weight: 121.2

Boiling Point: 206 to 207° C. (at 760 mm.)

Specific Gravity: 0.937 at 15° C.

Refractive Index: 1.5649

Solubility:

insoluble in water    ∞ (in alcohol)  
                                  ∞ (in ether)

N-METHYL p-TOLUIDINEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NHCH}_3$ 

Formula Weight: 121.2

Boiling Point:

206 to 208° C. (at 760 mm.)

209 to 211° C. (at 761 mm.)

Specific Gravity:

0.985(15/15)                      0.935(55/4)

Solubility:

insoluble in water    ∞ (in alcohol)  
                                  ∞ (in ether)

METHYL m-TOLYL ETHER

Synonyms:

m-cresyl methyl ether  
 3-methoxytoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OCH}_3$ 

Formula Weight: 122.2

Boiling Point:

172 to 177.2° C. (at 760 mm.)

Specific Gravity: 0.9766(15/15)

Refractive Index: 1.506

METHYL o-TOLYL ETHER

Synonyms:

o-cresyl methyl ether  
 2-methoxytoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OCH}_3$ 

Formula Weight: 122.2

Boiling Point:

171 to 177.3° C. (at 760 mm.)

Specific Gravity: 0.9851(15/15)

Refractive Index: 1.5199 at 15.3° C.

Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

METHYL p-TOLYL ETHER

Synonyms:

p-cresyl methyl ether  
 4-methoxytoluene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OCH}_3$ 

Formula Weight: 122.2

Boiling Point:

173 to 176.5° C. (at 760 mm.)

Specific Gravity:

0.976(15/15)                      0.9709(17.3/4)

Refractive Index: 1.51237 at 19.3° C.

METHYL p-TOLYL SULFIDE

Synonyms: thiocresol methyl ether

Formula:  $\text{CH}_3\text{SC}_6\text{H}_4\text{CH}_3$ 

Formula Weight: 138.2

Boiling Point: 209° C. (at 747 mm.)

Specific Gravity: 1.030(16/4)

METHYL TRICHLOROACETATE

Synonyms:  
trichloroacetic acid methyl ester

Formula:  $\text{CCl}_3\text{COOCH}_3$

Formula Weight: 177.4

Melting Point:  $-17.5^\circ\text{C}$ .

Boiling Point:  
 $153.8^\circ\text{C}$ . (at 760 mm.)  
 $152$  to  $153^\circ\text{C}$ . (at 765 mm.)

Specific Gravity: 1.4868(19.2/4)

Solubility:  
decomposes in water  
decomposes in alcohol  
soluble in ether

METHYL VALERATE

Synonyms:  
methyl pentanoate  
valeric acid methyl ester

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{COOCH}_3$

Formula Weight: 116.2

Melting Point:  $-91.0^\circ\text{C}$ .

Boiling Point:  $127.3^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.910 at  $0^\circ\text{C}$ .

Solubility:  
very slightly soluble in water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

MINERAL SPIRITS

Synonyms: petroleum spirits

Characteristics: pleasant, sweetish odor

Boiling Point:  $152$  to  $204^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:  
 $0.770$  to  $0.880$   $0.769$  at  $20^\circ\text{C}$ .  
 $6.40$  lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.42

Flash Point:  $86$  to  $105^\circ\text{F}$ . (closed)

Uses:  
solvent for paints, thinners, and  
varnishes

Solubility:  
very slightly soluble in water  
water is insoluble in mineral spirits

Additional Data:  
 $^\circ\text{API}$ ,  $50.0$   
kauri butanol number,  $32$   
doctor test, sweet  
sulfur,  $0.02\%$   
aniline number,  $140^\circ\text{F}$ .  
coefficient of expansion,  
 $0.00098$  at  $10$  to  $30^\circ\text{C}$ .  
heavy mineral spirits (heavy  
petroleum spirits) boils in the range  
of  $171$  to  $251^\circ\text{C}$ . with 95% below  
 $238^\circ\text{C}$ . (at 760 mm.) and has a flash  
point of  $125^\circ\text{F}$ .

MORPHOLINE

Synonyms:  
diethyleneimide oxide  
tetrahydro-1,4-oxazine

Formula:  $\text{O}(\text{CH}_2\text{CH}_2)_2\text{NH}$

Characteristics:  
oily, hygroscopic, ammoniacal odor

Formula Weight: 87.1

Melting Point:  $-3.1^\circ\text{C}$ .

Boiling Point:  
 $126$  to  $130^\circ\text{C}$ . (at 760 mm.)  
 $128.9^\circ\text{C}$ . (at 760 mm.)  
 $120$  to  $132^\circ\text{C}$ . (at 760 mm.)  
 $55^\circ\text{C}$ . (at 50 mm.)  
 $27^\circ\text{C}$ . (at 10 mm.)

Specific Gravity:  
 $0.9998$   $1.0017(20/20)$   
 $8.34$  lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4544

Vapor Pressure (mm. Hg):  $8.0$  at  $20^\circ\text{C}$ .

Viscosity (centipoises):  $2.37$  at  $20^\circ\text{C}$ .

Flash Point:  $100^\circ\text{F}$ . (open)

Heat of Fusion (Btu./lb.):  $187$

## MORPHOLINE (Cont.)

## Uses:

solvent for dyes, resins, emulsifying agents, and waxes  
organic syntheses  
floor polishes, corrosion inhibitors, rubless polishes, paper coatings, lacquers, insecticides, and paints

## Solubility:

very soluble in alcohol  
soluble in ether  $\infty$  (in water)  
soluble in ordinary organic solvents

## Additional Data:

pH of 25% solution at 25°C., 11.4

## 4-MORPHOLINEETHANOL

## Synonyms:

diethyleneimide oxide ethanol  
diethylene oxide 2-iminoethyl alcohol  
2-(4-morpholinyl) ethanol

Formula:  $O(CH_2CH_2)_2NCH_2CH_2OH$

Formula Weight: 131.2

Boiling Point: 225.5°C. (at 760 mm.)

## Specific Gravity:

1.071                      1.072(20/20)

Solubility:  $\infty$  (in water)

1-MUSCONE

## Synonyms:

3-methylcyclopentadecanone

Formula:  $CH_3C_{15}H_{27}O$

Characteristics: oily

Formula Weight: 238.4

Boiling Point: 328°C. (at 760 mm.)

Specific Gravity: 0.922(17/4)

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)

## MYRISTONITRILE

## Synonyms:

myristic acid nitrile  
tetradecanenitrile  
tridecyl cyanide

Formula:  $C_{13}H_{27}CN$

Formula Weight: 209.4

Melting Point: 19°C.

Boiling Point: 226.5°C. (at 100 mm.)

Specific Gravity: 0.8281(19/4)

## Solubility:

insoluble in water  
slightly soluble in alcohol  
very soluble in ether

## MYRISTOYL CHLORIDE

## Synonyms:

myristic acid chloride  
myristyl chloride  
tetradecanoyl chloride

Formula:  $CH_3(CH_2)_{12}COCl$

Formula Weight: 246.8

Melting Point: -1°C.

## Boiling Point:

168°C. (at 15 mm.)  
159 to 169°C. (at 11 mm.)

## Solubility:

decomposes in water  
decomposes in alcohol  
soluble in ether

## N

## NAPHTHA (Petroleum)

various petroleum distillates are termed naphthas and are sold under many trade names to be used as rubber solvents, extraction solvents, mineral spirits, varnish spirits, VMP naphtha and the like

## Narrow-cut Rubber Solvent

Boiling Point: 58 to 96° C. (at 760 mm.)

Specific Gravity: 0.702(60/60° F.)

## Wide-cut Rubber Solvent

Boiling Point: 39 to 138° C. (at 760 mm.)

Specific Gravity: 0.710(60/60° F.)

## Narrow-cut Extraction Naphtha

Boiling Point: 75 to 113° C. (at 760 mm.)

Specific Gravity: 0.724(60/60° F.)

## Wide-cut Extraction Naphtha

Boiling Point: 62 to 159° C. (at 760 mm.)

Specific Gravity: 0.735(60/60° F.)

## NAPHTHA (Solvent)

mixture of aromatic hydrocarbons containing mainly xylene, toluene, benzene, ethylbenzene, and higher homologues

## Light Grade

Boiling Point: 110 to 160° C. (at 760 mm.)

Specific Gravity: 0.865 to 0.875

## Heavy Grade

Boiling Point: 160 to 190° C. (at 760 mm.)

## 1-NAPHTHALDEHYDE

## Synonyms:

*d*-naphthoic aldehyde

1-naphthalenecarbonal

Formula:  $C_{10}H_7CHO$

Formula Weight: 156.2

Boiling Point: 291.6° C. (at 760 mm.)

Specific Gravity: 1.148(20/4)

Refractive Index: 1.65464 at 19.3° C.

## Solubility:

insoluble in water

soluble in alcohol      soluble in ether

## 1-NAPHTHALENETHIOL

## Synonyms:

*d*-naphthyl mercaptan

thio-1-naphthol

Formula:  $C_{10}H_7SH$

Formula Weight: 160.2

## Boiling Point:

decomposes at 285° C.

208.5° C. (at 200 mm.)

161° C. (at 20 mm.)

Specific Gravity: 1.155(20/4)

## Solubility:

very slightly soluble in w.

very soluble in alcohol

very soluble in ether

## NEOSOL #1

## Synonyms:

this is a commercial mixture of

85% sec-butyl acetate and

15% diacetone

Boiling Point: 105 to 168° C. (at 760 mm.)

## Specific Gravity:

0.8724(20/4)

7.27 lbs. per gal. at 20° C.

## NEOSOL #1 (Cont.)

Refractive Index: 1.3938

Flash Point: 66° F. (closed)

## Uses:

solvent for lacquers and lacquer thinners

## Additional Data:

dilution ratios at 8% final concentration of 1/2 sec. RS nitrocellulose diluent:

2.68 toluene1.54 high aromatic petroleum diluent

## NEROL

## Synonyms:

dimethyl-2,6-octadiene-8-ol(2,6)

3.7-dimethyl-2,6-octadien-1-ol

Formula:  $C_{10}H_{17}OH$ 

## Characteristics:

oily

rose-neroli odor

bitter taste

aroma of raspberry

Formula Weight: 154.3

## Boiling Point:

226 to 227° C. (at 760 mm.)

224 to 225° C. (at 745 mm.)

Specific Gravity: 0.881 at 15° C.

## Uses:

perfumes

synthetic raspberry and strawberry flavors

Solubility: soluble in alcohol

## Additional Data:

optically inactive

isomeric with geraniol

o-NITROANISOLE

## Synonyms:

1-methoxy-2-nitrobenzene

o-nitrophenylmethyl etherFormula:  $NO_2C_6H_4OCH_3$ 

## Characteristics:

light amber to light reddish

Formula Weight: 153.1

Melting Point: 9.4 to 10° C.

## Boiling Point:

272 to 277° C. (at 760 mm.)

268 to 271° C. (at 760 mm.)

## Specific Gravity:

1.2527(20/4)

1.255(20/20)

Refractive Index: 1.56188

## Uses:

organic syntheses of dye intermediates, pharmaceuticals, etc.

## Solubility (grams per 100 ml.):

0.169 at 30° C. (in water)

insoluble in cold water

 $\infty$  (in alcohol) $\infty$  (in ether)

Additional Data: toxic

## NITROBENZENE

## Synonyms:

essence of mirbane

essence of myrbane

nitrobenzide

nitrobenzol

oil of mirbane

oil of myrbane

Formula:  $C_6H_5NO_2$ 

## Characteristics:

bitter almond odor yellow

Formula Weight: 123.1

## Melting Point:

5.7° C.

8.7° C.

Boiling Point: 210.9° C. (at 760 mm.)

## Specific Gravity:

1.205(18/4)

1.19867(25/4)

Refractive Index: 1.55291

Flash Point: 190° F. (closed)

## Uses:

solvent for cellulose ethers  
manufacture of aniline, azobenzene, benzidine, cements, cosmetics, dye intermediates, dyes, dust preventatives, explosives, glues, greases, various other organic chemicals,

polishes, soaps, synthetic oil of almonds, toilet preparations, etc.

Solubility (grams per 100 ml.):

0.10 at 20° C., 0.8 at 80° C.,  
(in water)

very soluble in alcohol, benzene,  
and oils

Additional Data:

toxic

weight of vapor, 5.500 mg./*l*.

autoignition temperature, 924° F.

vapor density, 4.1

### 1-NITROBUTANE

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NO}_2$

Formula Weight: 103.1

Boiling Point: 151 to 152° C. (at 760 mm.)

Solubility:

very slightly soluble in water

∞ (in alcohol)      ∞ (in ether)

### 2-NITROBUTANE

Formula:  $\text{CH}_3\text{CH}_2\text{CHNO}_2\text{CH}_3$

Formula Weight: 103.1

Boiling Point: 138 to 139° C. (at 747 mm.)

Specific Gravity: 0.988 at 0° C.

### 2-NITRO-1-BUTANOL

Synonyms:  $\beta$ -nitrobutyl alcohol

Formula:  $\text{CH}_3\text{CH}_2\text{CH}(\text{NO}_2)\text{CH}_2\text{OH}$

Formula Weight: 119.1

Melting Point: -48 to -47° C.

Boiling Point: 105° C. (at 10 mm.)

Specific Gravity:

1.134(20/20)

9.44 lbs. per gal. at 20° C.

Refractive Index: 1.4390 at 20° C.

Uses:

heat sensitizer for rubber latex  
zein solvent

mild oxidizing agents

syntheses of flotation agents,

emulsifying agents, surface active  
agents, etc.

high boiling solvent

high boiling plasticizers

Solubility (grams per 100 ml.):

20 at 20° C. (in water)

∞ (in alcohol)      ∞ (in ether)

Additional Data:

pH of 0.1 M aqueous solution at 20° C.,  
4.5

### *d*-NITROCUMENE

Synonyms:

(*d*-nitroisopropyl) benzene

2-nitro-2-phenylpropane

Formula:  $\text{C}_6\text{H}_5\text{C}(\text{NO}_2)(\text{CH}_3)_2$

Formula Weight: 165.2

Melting Point: -35° C.

Boiling Point:

decomposes at 224° C.

123 to 128° C. (at 12 mm.)

Specific Gravity: 1.1025(20/0)

Solubility: insoluble in cold water

### 2-NITRO-p-CYMENE

Synonyms:

4-isopropyl-1-methyl-2-nitrobenzene

nitro-p-cymene (2;1,4)

Formula:  $\text{NO}_2\text{C}_6\text{H}_3(\text{CH}_3)\text{C}_3\text{H}_7$

Characteristics:

aromatic

oily

Formula Weight: 179.2

Boiling Point: 130 to 152° C. (at 15 mm.)

Specific Gravity: 1.067 to 1.0774(20/4)

Refractive Index: 1.53093

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## NITROETHANE

Formula:  $C_2H_5NO_2$ 

Characteristics: mild odor

Formula Weight: 75.1

Freezing Point:  $-90^{\circ}C$ .Boiling Point:  
 $114.0$  to  $114.8^{\circ}C$ . (at  $760$  mm.)Specific Gravity:  
 $1.052(20/20)$   
 $8.75$  lbs. per gal. at  $20^{\circ}C$ .Refractive Index:  
 $1.39007$  at  $24.3^{\circ}C$ .  $1.3916$  at  $20^{\circ}C$ .Surface Tension (dynes per cm.):  $31.3$ Flash Point:  
 $82^{\circ}F$ . (closed)  $106^{\circ}F$ . (open)Uses:  
solvent for cellulose acetate, aceto-  
butyrate, and triacetate, dyes, fats,  
nitrocellulose, oils, synthetic resins  
like alkyds and vinyls, waxes, etc.  
syntheses of dyes, emulsifying agents,  
insecticides, larvicides, pharma-  
ceuticals, photographic chemicals,  
textile chemicals, wetting agents, etc.Solubility (grams per 100 ml.):  
 $4.5$  (in cold water)  
 $0.9$  (water in 100 cc. nitroethane)  
 $\infty$  (in alcohol)  $\infty$  (in ether)  
very soluble in chloroform  
soluble in dilute alkaliesAdditional Data:  
pH of  $0.01$  M aqueous solution  
at  $20^{\circ}C$ .,  $6.0$   
vapor density,  $2.58$   
rate of evaporation by weight  
(n-butyl acetate =  $100$ ),  $145$ 

## 2-NITROETHANOL

Synonyms:  
 $2$ -nitroethanol-1 nitroethyl alcoholFormula:  $NO_2CH_2CH_2OH$ Formula Weight:  $91.1$ Melting Point:  $<-80^{\circ}C$ .Boiling Point:  
 $193.8^{\circ}C$ . (at  $760$  mm.)  
 $194^{\circ}C$ . (at  $765$  mm.)Specific Gravity:  $1.270(15/4)$ Solubility:  
very soluble in water  
very soluble in alcohol  
very soluble in ether

## NITROFORM

Synonyms: trinitromethane

Formula:  $CH(NO_2)_3$ 

Characteristics: oily

Formula Weight:  $151.0$ Melting Point:  $15^{\circ}C$ .Boiling Point:  
 $45$  to  $47^{\circ}C$ . (at  $22$  mm.); exp.Specific Gravity:  $1.5967(24.3/4)$ Solubility:  
soluble in water soluble in ether

## NITROGLYCERIN

Synonyms:  
explosive oil glyceryl trinitrate  
glonoin oil trinitroglycerol  
glycerol trinitrateFormula:  $C_3H_5(ONO_2)_3$ Characteristics:  
colorless to yellow  
viscous  
inflammableFormula Weight:  $227.1$ Melting Point:  
 $2.9^{\circ}C$ .  $11$  to  $13.2^{\circ}C$ .Boiling Point:  
 $260$  to  $270^{\circ}C$ . (at  $760$  mm.) exp.  
 $160^{\circ}C$ . (at  $15$  mm.)Specific Gravity:  $1.601$  at  $15^{\circ}C$ .Refractive Index:  $1.482$  at  $18.6^{\circ}C$ .

Flash Point: explodes

## Uses:

dynamite, other explosives  
medicine

## Solubility (grams per 100 ml.):

0.18 at 20° C. (in water)

25 (in alcohol)

7 (in methanol)

∞ (in ether)

## Additional Data:

autoignition temperature, 518° F.

vapor density, 7.84

## 1-NITROHENDECANE

Synonyms: 1-nitroundecane

Formula:  $\text{CH}_3(\text{CH}_2)_9\text{CH}_2\text{NO}_2$

Characteristics: yellow

Formula Weight: 201.3

Boiling Point: decomposes

Specific Gravity: 0.900 at 15° C.

## Solubility:

very soluble in alcohol

very soluble in ether

## 1-NITROHEPTANE

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{NO}_2$

Characteristics:

pale yellow                      oily

Formula Weight: 145.2

Boiling Point: 193 to 195° C. (at 760 mm.)

Specific Gravity: 0.948 at 17° C.

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## 1-NITROHEXANE

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{NO}_2$

Formula Weight: 131.2

Boiling Point: 193 to 194° C. (at 765 mm.)

Specific Gravity: 0.949 at 20° C.

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in alcoholic solutions of  
alkalies

## NITROMETHANE

Formula:  $\text{CH}_3\text{NO}_2$

Characteristics:

mild odor                      oily

Formula Weight: 61.0

Freezing Point: -29° C.

Boiling Point: 101° C. (at 760 mm.)

Specific Gravity:

1.138(20/20)                      1.130(20/4)

9.5 lbs. per gal. at 20° C.

Refractive Index: 1.3818

Surface Tension (dynes per cm.): 37.0

Flash Point:

95° F. (closed)                      112° F. (open)

Uses: same as for nitroethane

Solubility (ml. per 100 ml.):

2.2 (of water)                      9 to 10 (in water)

soluble in alcohol, ether, and alkalies

Additional Data:

vapor density, 2.11

pH of 0.01 M aqueous solution

at 25° C., 6.4

rate of evaporation by weight

(n-butyl acetate = 100), 180

## 1-NITRONONANE

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{CH}_2\text{NO}_2$

Characteristics: pale yellow

Formula Weight: 173.3

Boiling Point:

215 to 218° C. (with decomposition)

Specific Gravity: 0.923 at 17° C.

## 1-NITROOCTANE

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{NO}_2$ 

Characteristics: pale yellow

Formula Weight: 159.2

Boiling Point:

206 to 210°C. (with slight decomposition)

Specific Gravity: 0.935 at 20°C.

## 1-NITROPENTANE

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{NO}_2$ 

Formula Weight: 117.2

Boiling Point: 172 to 173°C. (at 760 mm.)

Specific Gravity: 0.948 at 20°C.

## 3-NITROPENTANE

Formula:  $(\text{C}_2\text{H}_5)_2\text{CHNO}_2$ 

Formula Weight: 117.2

Boiling Point: 152 to 155°C. (at 746 mm.)

Specific Gravity: 0.958 at 0°C.

Solubility:

insoluble in water      soluble in alcohol  
soluble in ethero-NITROPHENETOLESynonyms: ethyl o-nitrophenyl etherFormula:  $\text{NO}_2\text{C}_6\text{H}_4\text{OC}_2\text{H}_5$ 

Characteristics:

yellow                      oily

Formula Weight: 167.2

Melting Point:

2.1°C.                      5 to 6°C.

Boiling Point:

268 to 275°C. (at 760 mm.)

149.3°C. (at 6 mm.)

Specific Gravity: 1.190 at 15°C.

Refractive Index: 1.5425

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## 2-NITROPHENYL PHENYL ETHER

Synonyms: nitrodiphenyl ether (2)

Formula:  $\text{C}_6\text{H}_5\text{OC}_6\text{H}_4\text{NO}_2$ 

Characteristics:

yellow                      oily

Formula Weight: 215.2

Melting Point: &lt; -20°C.

Boiling Point: 235°C. (at 60 mm.)

Specific Gravity: 1.258 at 15°C.

Solubility:

insoluble in water  
soluble in benzene  
soluble in absolute alcohol

## 3-NITROPHENYL PHENYL ETHER

Synonyms: nitrodiphenyl ether (3)

Formula:  $\text{C}_6\text{H}_5\text{OC}_6\text{H}_4\text{NO}_2$ 

Characteristics:

yellow                      oily

Formula Weight: 215.2

Boiling Point: 202 to 204°C. (at 14 mm.)

Specific Gravity: 1.245 at 15°C.

## 1-NITROPROPANE

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NO}_2$ 

Characteristics:

mild odor                      oily

Formula Weight: 89.1

Melting Point: -108°C.

Boiling Point: 131.6°C. (at 760 mm.)

Specific Gravity:

1.003(20/20)

8.35 lbs. per gal. at 20°C.

Refractive Index:

1.4015 at 20°C.

1.40027 at 24.3°C.

Surface Tension (dynes per cm.): 30.0

Uses: same as for nitroethane

Solubility (ml. per 100 ml.):

1.7 (of water)  $\infty$  (in alcohol)  
1.4 (in water)  $\infty$  (in ether)

Additional Data:

pH of 0.01 M aqueous solution  
at 25°C., 6.0  
vapor density, 3.06  
rate of evaporation by weight  
(n-butyl acetate = 100), 100

## 2-NITROPROPANE

Synonyms:  $\beta$ - or sec-nitropropane

Formula:  $(\text{CH}_3)_2\text{CHNO}_2$

Characteristics: mild odor

Formula Weight: 89.1

Melting Point: -93°C.

Boiling Point: 120.3°C. (at 760 mm.)

Specific Gravity:

1.024 at 0°C. 0.992(20/20)  
8.24 lbs. per gal. at 20°C.

Refractive Index: 1.3941

Surface Tension (dynes per cm.): 30.0

Flash Point:

75°F. (closed) 103°F. (open)

Uses: same as for nitroethane

Solubility (ml. per 100 ml.):

0.6 (of water)  $\infty$  (in alcohol)  
0.5 (in water)  $\infty$  (in ether)

Additional Data:

pH of 0.01 M aqueous solution  
at 25°C., 6.2  
vapor density, 3.06  
rate of evaporation by weight  
(n-butyl acetate = 100), 124

## 3-NITRO-1-PROPENE

Synonyms:

nitroallyl nitropropene-3, 1

Formula:  $\text{CH}_2=\text{CHCH}_2\text{NO}_2$

Formula Weight: 87.1

Boiling Point: 125 to 130°C. (at 760 mm.)

Specific Gravity: 1.051 at 21°C.

Solubility:

insoluble in water soluble in alcohol  
soluble in ether

## N-NITROSODIETHYLAMINE

Synonyms:

diethylnitrosoamine  
nitrous diethylamide

Formula:  $(\text{C}_2\text{H}_5)_2\text{NNO}$

Characteristics:

yellow oily

Formula Weight: 74.1

Boiling Point: 176.9°C. (at 760 mm.)

Specific Gravity: 0.943(20/4)

Refractive Index: 1.4386 at 19.9°C.

Solubility:

soluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## N-NITROSODIMETHYLAMINE

Synonyms:

dimethylnitrosamine  
nitrous dimethylamide

Formula:  $(\text{CH}_3)_2\text{NNO}$

Characteristics:

yellow oily

Formula Weight: 74.1

Boiling Point: 153°C. (at 774 mm.)

Specific Gravity:

1.006(20/4) 1.0049(18/4)

Refractive Index: 1.43743 at 18°C.

Solubility:

soluble in water, alcohol, and ether

## N-NITROSODIPROPYLAMINE

Synonyms:

dipropylnitrosamine  
nitrous dipropylamide

N-NITROSODIPROPYLAMINE (Cont.)Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{NNO}$ 

Characteristics:

yellow                      oily

Formula Weight: 130.2

Boiling Point: 205° C. (at 760 mm.)

Specific Gravity:

0.916(20/4)                      0.910(25/4)

Solubility:

very slightly soluble in water

 $\infty$  (in alcohol)                       $\infty$  (in ether)

## 1-NITROSOPIPERIDINE

Formula:  $\text{C}_5\text{H}_{10}\text{NNO}$ 

Characteristics:

pale yellow                      oily

Formula Weight: 114.2

Boiling Point: 217 to 218° C. (at 760 mm.)

Specific Gravity: 1.063(18.5/4)

Solubility: soluble in water

m-NITROSTYRENE

Synonyms: 1-nitro-3-vinylbenzene

Formula:  $\text{NO}_2\text{C}_6\text{H}_4\text{CH}:\text{CH}_2$ 

Characteristics:

yellow                      oily

Formula Weight: 149.1

Melting Point: -5° C.

Solubility:

very soluble in alcohol

soluble in alcohol, ether, and ligroin

o-NITROSTYRENE

Synonyms: 1-nitro-2-vinylbenzene

Formula:  $\text{NO}_2\text{C}_6\text{H}_4\text{CH}:\text{CH}_2$ 

Characteristics: oily

Formula Weight: 149.1

Melting Point: 12 to 13.5° C.

Solubility:

soluble in concentrated sulfuric acid

m-NITROTOLUENE

Synonyms:

m-methylnitrobenzenem-methylnitrobenzolm-nitrotoluolFormula:  $\text{NO}_2\text{C}_6\text{H}_4\text{CH}_3$ 

Formula Weight: 137.1

Melting Point: 15.5 to 16° C.

Boiling Point: 230 to 231° C. (at 760 mm.)

Specific Gravity:

1.160(18/4)                      1.157(20/4)

Refractive Index: 1.5475

Solubility (grams per 100 ml.):

0.0498 at 20 (in water)

soluble in benzene

soluble in chloroform

 $\infty$  (in alcohol)                       $\infty$  (in ether)o-NITROTOLUENE

Synonyms:

o-methylnitrobenzeneo-methylnitrobenzolo-nitrotoluolFormula:  $\text{NO}_2\text{C}_6\text{H}_4\text{CH}_3$ 

Characteristics: yellow

Formula Weight: 137.1

Melting Point:

 $\alpha$ -10.6° C.                       $\beta$ -4.1° C.

Boiling Point: 222.3° C. (at 760 mm.)

Specific Gravity: 1.163(20/4)

Refractive Index: 1.54739 at 20.4° C.

Solubility (grams per 100 ml.):

0.0652 at 30 (in water)

soluble in benzene

soluble in petroleum ether

 $\infty$  (in alcohol)                       $\infty$  (in ether) $\alpha$ -NITROTOLUENE

Synonyms:

 $\omega$ -nitrotoluene

phenylnitromethane

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{NO}_2$

Characteristics: yellow

Formula Weight: 137.1

Boiling Point:

141 to 142° C. (at 35 mm.)  
with slight decomposition

Specific Gravity: 1.160(20/0)

#### 2-NITRO-m-XYLENE

Synonyms: nitro-m-xylene (3; 1, 2)

Formula:  $\text{NO}_2\text{C}_6\text{H}_3(\text{CH}_3)_2$

Formula Weight: 151.2

Boiling Point: 225° C. (at 744 mm.)

Specific Gravity: 1.112 at 15° C.

Solubility:

insoluble in water    soluble in ether

#### 3-NITRO-o-XYLENE

Synonyms: nitro-o-xylene (2; 1, 3)

Formula:  $\text{NO}_2\text{C}_6\text{H}_3(\text{CH}_3)_2$

Characteristics:

yellow                      oily

Formula Weight: 151.2

Melting Point: 15° C.

Boiling Point: 240 to 245° C. (at 760 mm.)

Specific Gravity: 1.147 at 15° C.

#### 4-NITRO-m-XYLENE

Synonyms: nitro-m-xylene (4; 1, 3)

Formula:  $\text{NO}_2\text{C}_6\text{H}_3(\text{CH}_3)_2$

Characteristics: yellow

Formula Weight: 151.2

Melting Point: 2° C.

Boiling Point: 244° C. (at 760 mm.)

Specific Gravity: 1.135 at 15° C.

Solubility:

insoluble in water    soluble in ether

#### 2-NITRO-p-XYLENE

Synonyms: nitro-p-xylene (2; 1, 4)

Formula:  $\text{NO}_2\text{C}_6\text{H}_3(\text{CH}_3)_2$

Characteristics: yellow

Formula Weight: 151.2

Boiling Point: 238.9° C. (at 739 mm.)

Specific Gravity: 1.132 at 15° C.

Solubility:

insoluble in water    soluble in ether

#### NONANE

Synonyms:

n-nonane                      nonyl hydride

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{CH}_3$

Formula Weight: 128.3

Melting Point: -53.7 to -51° C.

Boiling Point: 150.7° C. (at 760 mm.)

Specific Gravity:

0.718(20/4)                      0.7177 at 20° C.

Refractive Index:

1.40561                      1.40549

Inflammability Range (volume per cent  
in air):

0.74 (lower limit)    2.9 (upper limit)

Flash Point: 88° F. (closed)

Specific Heat (Btu./lb. per ° F. at 77° F.)  
(liquid): 0.523

Heat of Vaporization (Btu./lb.):

126.65 at the boiling point

155.67 at 77° F.

Uses: organic syntheses

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

Additional Data:

vapor density, 4.41

specific gravity of gas (ideal)

(air = 1.0), 4.4276

specific gravity of liquid (in vacuo)

at 20/4° C., 0.71770

at 60/60° F., 0.72182

## NONANE (Cont.)

API gravity (at 60° F.), 64.50  
 liquid density (in vacuo) at 60° F.,  
 6.0180  
 aniline point, 165.9  
 critical temperature, 613° F.  
 critical pressure, 335 psia.  
 coefficient of expansion,  
 0.00060 at 32 to 104° F.  
 total heating values (at 77° F.):  
 20,531 Btu./lb.  
 122,310 Btu./cu. ft.-gas

## NONANENITRILE

## Synonyms:

octyl cyanide  
 pelargonitrile  
 pelargonic acid nitrile

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{CN}$

Formula Weight: 139.2

Melting Point: -34.2° C.

## Boiling Point:

214 to 216° C. (at 760 mm.)  
 224.0° C. (at 760 mm.)

## Specific Gravity:

0.8331 at 0° C.      0.786 at 16° C.

## Solubility:

insoluble in water    soluble in ether  
 slightly soluble in alcohol

## 1-NONANETHIOL

Formula:  $\text{C}_9\text{H}_{20}\text{S}$

Formula Weight: 160.1

Melting Point: -25° C.

## Boiling Point:

220° C. (at 760 mm.)  
 149° C. (at 100 mm.)  
 92° C. (at 10 mm.)

## Specific Gravity:

0.844 at 20° C.      0.840 at 25° C.

## Refractive Index:

1.460 at 20° C.      1.454 at 25° C.

## 2-NONANETHIOL

Formula:  $\text{C}_9\text{H}_{20}\text{S}$

Formula Weight: 160.1

Melting Point: -69° C.

## Boiling Point:

208° C. (at 760 mm.)  
 138° C. (at 100 mm.)  
 82° C. (at 10 mm.)

## Specific Gravity:

0.838 at 20° C.      0.834 at 25° C.

Refractive Index: 1.450 at 25° C.

## 2-NONANOL

Synonyms: heptylmethylcarbinol

Formula:  $\text{CH}_3\text{CHOH}(\text{CH}_2)_6\text{CH}_3$

Formula Weight: 144.3

Melting Point: -35° C.

## Boiling Point:

193 to 194° C. (at 760 mm.)  
 198.3° C. (at 760 mm.)

## Specific Gravity:

0.8910(25/4)      0.823(20/4)

Refractive Index: 1.4290 at 25° C.

## Solubility:

insoluble in water    soluble in alcohol  
 soluble in ether

## 3-NONANOL

Synonyms: ethylhexylcarbinol

Formula:  $\text{CH}_3\text{CH}_2\text{CHOH}(\text{CH}_2)_5\text{CH}_3$

Formula Weight: 144.3

Melting Point: -22° C.

Boiling Point: 194 to 195° C. (at 750 mm.)

Specific Gravity: 0.825(20/4)

## Solubility:

insoluble in water  
 very soluble in alcohol  
 very soluble in ether

## 4-NONANOL

Synonyms: amylpropylcarbinol

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CHOH}(\text{CH}_2)_4\text{CH}_3$

Formula Weight: 144.3

Boiling Point: 192 to 193° C. (at 760 mm.)

Specific Gravity: 0.8282

Solubility:

insoluble in water      soluble in alcohol  
                                      soluble in ether

## 5-NONANOL

Synonyms: dibutylcarbinol

Formula:  $(\text{C}_4\text{H}_9)_2\text{CHOH}$

Characteristics:

viscous                      oily

Formula Weight: 144.3

Boiling Point: 194° C. (at 760 mm.)

Specific Gravity: 0.823 at 20° C.

Refractive Index: 1.4289 at 18° C.

Solubility:

insoluble in water      ∞ (in alcohol)  
                                      ∞ (in ether)

## 2-NONANONE

Synonyms: heptyl methyl ketone

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_6\text{CH}_3$

Characteristics:

colorless  
agreeable aroma of rue

Formula Weight: 142.2

Melting Point:

-19° C.                      -8.2° C.

Boiling Point: 194 to 196° C. (at 760 mm.)

Specific Gravity:

0.8317 at 20° C.      0.835

Uses: synthetic rue flavors

Solubility:

insoluble in water      soluble in alcohol  
                                      soluble in ether

## 3-NONANONE

Synonyms: ethyl hexyl ketone

Formula:  $\text{C}_2\text{H}_5\text{CO}(\text{CH}_2)_5\text{CH}_3$

Formula Weight: 142.2

Melting Point: -8° C.

Boiling Point: 190° C. (at 760 mm.)

Specific Gravity: 0.840 at 0° C.

Solubility:

soluble in alcohol      soluble in ether

## 5-NONANONE

Synonyms: dibutyl ketone

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2)_2\text{CO}$

Formula Weight: 142.2

Melting Point: -5.9° C.

Boiling Point:

181 to 182° C. (at 760 mm.)

186 to 187° C. (at 760 mm.)

188 to 192° C. (at 760 mm.)

Specific Gravity: 0.8270(13/4)

Refractive Index: 1.421 at 15° C.

Solubility:

very slightly soluble in water  
very soluble in chloroform  
very soluble in carbon disulfide  
soluble in alcohol      soluble in ether

## 1-NONENE

Synonyms: *n*-nonylene

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}:\text{CH}_2$

Formula Weight: 126.2

Boiling Point: 149.9° C. (at 760 mm.)

Specific Gravity:

0.7302 at 20° C.

6.119 lbs. per gal. at 60° F.

Refractive Index: 1.416

Uses: organic syntheses

Solubility:

insoluble in water      soluble in alcohol  
                                      soluble in ether

## 1-NONENE (Cont.)

## Additional Data:

aniline point, 100.4° F.

## 2-NONENE

Synonyms:  $\beta$ -nonylene

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}:\text{CHCH}_3$

Formula Weight: 126.2

Boiling Point: 148 to 149° C. (at 760 mm.)

Specific Gravity: 0.754(15/15)

Solubility: insoluble in water

## NONYL ALCOHOL

Synonyms: 1-nonanol

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{CH}_2\text{OH}$

## Characteristics:

colorless to yellow  
 rose-like, fatty odor resembling  
 citronella  
 peach flavor                      bitter taste

Formula Weight: 144.3

Melting Point: -5° C.

## Boiling Point:

213.5 to 215° C. (at 760 mm.)

## Specific Gravity:

0.8274(20/4)                      0.840

Refractive Index: 1.43347

## Uses:

synthetic perfumes  
 synthetic apricot, lemon, orange,  
 peach, and pineapple flavors

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
     $\infty$  (in ether)  
 one volume dissolves  
 in 12 parts of 50% alcohol

## NONYLAMINE

Synonyms: 1-aminononane

Formula:  $\text{CH}_3(\text{CH}_2)_7\text{CH}_2\text{NH}_2$

Formula Weight: 143.3

## Boiling Point:

201 to 202.2° C. (at 760 mm.)

## Solubility:

slightly soluble in water  
 soluble in alcohol      soluble in ether

## NONYLBENZENE

Formula:  $\text{C}_9\text{H}_{19}\text{C}_6\text{H}_5$

## Characteristics:

light straw color  
 faint aromatic odor

Formula Weight: 204.3

Freezing Point: -60° C.

Boiling Point: 242 to 252° C. (at 760 mm.)

Specific Gravity: 0.864(20/20)

Refractive Index: 1.488

Viscosity (centipoises): 41.9 at 20° C.

Flash Point: 210° F. (closed)

## Solubility:

soluble in ether, acetone, benzene,  
 gasoline, and ethyl acetate  
 insoluble in water and methanol

## NONYLNAPHTHALENE

Formula:  $\text{C}_9\text{H}_{19}\text{C}_{10}\text{H}_7$

## Characteristics:

straw color  
 faint naphthalene odor

Formula Weight: 254.4

Freezing Point: -10° C.

Boiling Point: 330 to 345° C. (at 760 mm.)

Specific Gravity: 0.947(20/20)

Refractive Index: 1.555

Viscosity (centipoises): 60.8 at 20° C.

Flash Point: >200° F. (closed)

## Solubility:

insoluble in water and methanol  
 soluble in ether, acetone, benzene,  
 gasoline, and ethyl acetate

## NONYLPHENOL

Formula:  $\text{C}_9\text{H}_{19}\text{C}_6\text{H}_4\text{OH}$ 

## Characteristics:

straw color                      faint phenol odor

Formula Weight: 220.3

Freezing Point:  $<0^\circ\text{C}$ .Boiling Point:  $295$  to  $304^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.968(20/20)$ Refractive Index:  $1.517$ Flash Point:  $285^\circ\text{F}$ . (closed)

Uses: organic syntheses

## Solubility:

insoluble in water

soluble in methanol, ether, acetone,  
benzene, gasoline, and ethyl acetate

## 1-NONYNE

## Synonyms:

heptylacetylene                      1-nonine

Formula:  $\text{CH}_3\text{C}(\text{CH}_2)_6\text{CH}_3$ 

Formula Weight: 124.2

Melting Point:  $-36^\circ\text{C}$ .Boiling Point:  $160^\circ\text{C}$ . (at 745 mm.)

Specific Gravity: 0.7924

## Solubility:

insoluble in water                      soluble in alcohol  
soluble in ether

## O

## OCTADECANE

Formula:  $\text{CH}_3(\text{CH}_2)_{16}\text{CH}_3$ 

Formula Weight: 254.5

Melting Point:  $27.4$  to  $30^\circ\text{C}$ .

## Boiling Point:

 $317^\circ\text{C}$ . (at 760 mm.) $308^\circ\text{C}$ . (at 760 mm.)Specific Gravity:  $0.7768(28/4)$ 

## Refractive Index:

 $1.4379$  at  $35.2^\circ\text{C}$ .                       $1.4367$  at  $28^\circ\text{C}$ .

Uses: organic syntheses

## Solubility:

insoluble in water                      soluble in ether  
slightly soluble in alcohol

## 1-OCTADECENE

Synonyms:  $\alpha$ -octadecyleneFormula:  $\text{CH}_3(\text{CH}_2)_{15}\text{CH}:\text{CH}_2$ 

Formula Weight: 252.5

Melting Point:  $18^\circ\text{C}$ .Boiling Point:  $179^\circ\text{C}$ . (at 15 mm.)

## Specific Gravity:

 $0.791(18/4)$                        $0.793(20/4)$ Refractive Index:  $1.4456$ 

## OCTANE

Synonyms: octyl hydride

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}_3$ 

Formula Weight: 114.2

Melting Point:  $-56.5^\circ\text{C}$ .

## Boiling Point:

 $124.6$  to  $125.8^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

 $0.7036(20/4)$                        $0.7028(20/4)$ 

## Refractive Index:

 $1.3975$                        $1.3976$

## OCTANE (Cont.)

Inflammability Range (volume per cent in air):

0.84 to 0.95 (lower limit)

3.2 (upper limit)

Flash Point: 57.00 F. (closed)

Specific Heat (Btu./lb. per °F. at 77° F.)  
(liquid): 0.526

Heat of Vaporization (Btu./lb.):

131.65 at the boiling point

156.14 at 77° F.

Uses: organic syntheses

Solubility (grams per 100 ml.):

0.0015 at 16° C. (in water)

slightly soluble in alcohol

soluble in ether

Additional Data:

specific gravity of gas (ideal,

air = 1.0), 3.9434

specific gravity of liquid (in vacuo),

at 20/40° C., 0.70260

at 60/60° F., 0.70688

API gravity (at 60° F.), 68.7

liquid density (in vacuo) at 60° F.,

5.8934 lbs./gal.

critical temperature, 296.2° C.

critical pressure, 24.7 atm.

coefficient of expansion,

0.00063 at 32 to 104° F.

autoignition temperature, 450° F.

vapor density, 3.86

total heating values (at 77° F.),

20,591 Btu./lb.

120,040 Btu./gal. - liquid

aniline point, 161.1° F.

## OCTANE (mixed)

Synonyms:

this is a commercial mixture of  
isomeric octanes containing no  
olefines

the sulfur content is 0.015% by  
weight or less

Boiling Point: 93 to 126° C. (at 760 mm.)

Specific Gravity:

0.736 at 60/60° F.

6.13 lbs. per gal. at 60° F.

Uses:

solvent and thinner

cleaning compound

fuel for lamps and stoves

reference motor fuel

reaction medium

Vapor Pressure (psia. abs.):

2.4 at 70° F.

5.4 at 130° F.

3.0 at 100° F.

## 2,3-OCTANEDIONE

Synonyms: acetylcaproyl

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{COCOCH}_3$

Formula Weight: 142.2

Boiling Point: 172 to 173° C. (at 733 mm)

## 1-OCTANETHIOL

Synonyms: octyl mercaptan-1

Formula:  $\text{C}_8\text{H}_{17}\text{SH}$

Formula Weight: 146.3

Melting Point: -49.2° C.

Boiling Point:

199.1° C. (at 760 mm.)

75° C. (at 10 mm.)

Specific Gravity:

0.841 at 20° C.

0.8395(25/4)

0.837 at 25° C.

Refractive Index: 1.4497 at 25° C.

## 2-OCTANETHIOL

Formula:  $\text{C}_8\text{H}_{18}\text{S}$

Formula Weight: 146.3

Melting Point: -79° C.

Boiling Point:

186° C. (at 760 mm.)

119° C. (at 100 mm.)

65° C. (at 10 mm.)

Specific Gravity:

0.837 at 20° C.

0.833 at 25° C.

Refractive Index: 1.448 at 25° C.

## 2-OCTANOL

Synonyms:

capryl alcohol  
methylhexylcarbinol  
sec-n-octyl alcohol

Formula:  $\text{CH}_3\text{CHOH}(\text{CH}_2)_5\text{CH}_3$

Characteristics:

refractive                      oily  
aromatic disagreeable odor

Formula Weight: 130.2

Melting Point:  $-38.6^\circ\text{C}$ .

Boiling Point:

178.5 to  $180^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.8193                      0.825 at  $15^\circ\text{C}$ .  
0.822(20/4)

Refractive Index:

1.4260                      1.437

Uses:

organic syntheses      perfumery

Solubility:

insoluble in water  
very soluble in alcohol  
very soluble in ether

## 2-OCTANONE

Synonyms: hexyl methyl ketone

Formula:  $\text{CH}_3\text{CO}(\text{CH}_2)_5\text{CH}_3$

Characteristics:

depending on the source it has a bitter  
burning taste and a caraway flavor or  
else a sweet taste and a mignonette  
odor

peach aroma

Formula Weight: 128.2

Melting Point:  $-20.9$  to  $-16^\circ\text{C}$ .

Boiling Point:

172.9 to  $173.5^\circ\text{C}$ . (at 760 mm.)  
169 to  $173^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.818                      0.820 at  $20^\circ\text{C}$ .  
0.819(20/4)

6.82 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.41613

Flash Point:  $160^\circ\text{F}$ . (closed)

Uses:

synthetic apricot, peach, and plum  
essences for the sweet type  
synthetic caraway essences for the  
bitter type

Solubility (grams per 100 ml.):

0.6 at  $20^\circ\text{C}$ . (of water)  
0.09 at  $20^\circ\text{C}$ . (in water)  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

Additional Data:

coefficient of expansion,  
0.00092 at 10 to  $30^\circ\text{C}$ .  
dilution ratios:  
with toluene. . . . . 3.6  
with petroleum naphtha . . . . 0.9

## 3-OCTANONE

Synonyms: amyl ethyl ketone

Formula:  $\text{C}_2\text{H}_5\text{CO}(\text{CH}_2)_4\text{CH}_3$

Characteristics:

agreeable, aromatic, penetrating, fruity  
odor  
bitter-sweet taste      fruity flavor

Formula Weight: 128.2

Boiling Point:

$168^\circ\text{C}$ . (at 760 mm.)  
169 to  $170^\circ\text{C}$ . (at 738 mm.)

Specific Gravity:

0.850(0/4)                      0.825

Uses:

synthetic apricot and peach flavors

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 1-OCTENE

Synonyms:

caprylene                       $\alpha$ -octylene

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}:\text{CH}_2$

Formula Weight: 112.2

Melting Point:  $-104^\circ\text{C}$ .

## 1-OCTENE (Cont.)

## Boiling Point:

123 to 126.00°C. (at 760 mm.)

122.50°C. (at 760 mm.)

## Specific Gravity:

0.722 at 17°C.

0.7159(20/4)

0.721(18/4)

## Refractive Index:

1.4087

1.4103

## Specific Heat (Btu./lb. per °F.

at 32 to 120°F.) (liquid): 0.486

## Heat of Vaporization (Btu./lb.):

129.1 at the boiling point

Uses: organic syntheses

## Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## Additional Data:

specific gravity of gas (ideal,  
air = 1.0), 3.8738specific gravity of liquid at 20/40°C.,  
0.7160, at 60/60°F., 0.7204

API gravity (at 60°F.): 64.9

liquid density (in vacuo) at 60°F.,  
6.006

aniline point, 90.5°F.

critical temperature, 581°F.

coefficient of expansion,

0.00065 at 60 to 77°F.

total heating values at 77°F.,  
20,350 Btu./lb.

120,900 Btu./cu. ft. - gas

## OCTYL ACETATE

## Synonyms:

acetic acid n-octyl estercaprylyl acetate n-octyl acetateFormula:  $\text{CH}_3\text{COO}(\text{CH}_2)_7\text{CH}_3$ 

## Characteristics:

fruity odor

peach flavor

sweet taste

Formula Weight: 172.3

Melting Point: -38.5°C.

Boiling Point: 208 to 210°C. (at 760 mm)

## Specific Gravity:

0.873 to 0.874

0.885(0/4)

Flash Point: 180°F. (closed)

Uses: synthetic peach flavors

## Solubility:

insoluble in water

soluble in alcohol

soluble in ether

one volume is soluble

in 15 volumes of 60% alcohol and

in 3 volumes of 70% alcohol

Additional Data: vapor density, 5.93

## OCTYL ALCOHOL

## Synonyms:

capryl alcohol

octoic alcohol

caprylic alcohol

octyl alcohol

heptyl carbinol

(n-primary)

1-octanol

octylic alcohol

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{OH}$ 

## Characteristics:

characteristic penetrating aromatic  
odor somewhat resembling lemon

Formula: 130.2

Melting Point: -16.3 to -15.4°C.

## Boiling Point:

194 to 195.2°C. (at 760 mm.)

## Specific Gravity:

0.8246 to 0.827(20/4)

0.8187(25/4)

## Refractive Index:

1.42920

1.4303 at 15°C.Flash Point: 178°F. (closed)

## Uses:

organic syntheses

eau de Cologne type of perfumes

synthetic apricot, peach, and quince  
flavors

## Solubility:

insoluble in water

∞ (in ether)

∞ (in alcohol)

∞ (in chloroform)

Additional Data: vapor density, 4.48

## OCTYLAMINE

## Synonyms:

1-aminooctane  
pri-n-octylamine  
mono-n-octylamine

Formula:  $\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{NH}_2$

Characteristics: amine odor

Formula Weight: 129.2

Melting Point:  $-0.5^\circ\text{C}$ .

Boiling Point:

179.6 to  $180^\circ\text{C}$ . (at 760 mm.)  
 175 to  $177^\circ\text{C}$ . (at 745 mm.)  
170 to  $179^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.777 at  $27^\circ\text{C}$ .      0.776 at  $25^\circ\text{C}$ .  
0.779(20/20)

Refractive Index:

1.430      1.431

Flash Point:  $140^\circ\text{F}$ . (closed)

Solubility:

slightly soluble in water  
 very soluble in alcohol and ether  
 soluble in acetone, methanol, benzene,  
 gasoline, and ethyl acetate

Additional Data:

coefficient of expansion,  
0.00126 per  $^\circ\text{C}$ .

## OCTYL "CELLOSOLVE"

Synonyms:

ethylene glycol monooctyl ether

Formula:

$\text{C}_4\text{H}_9\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$

Formula Weight: 174.0

Boiling Point:  $228.3^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.8859(20/20)  
7.4 lbs. per gal. at  $20^\circ\text{C}$ .

Vapor Pressure (mm. Hg): 0.02 at  $20^\circ\text{C}$ .

Flash Point:  $230^\circ\text{F}$ . (closed)

## OCTYL DISULFIDE

Synonyms: dioctyl disulfide

Formula:  $(\text{C}_8\text{H}_{17})_2\text{S}_2$

Formula Weight: 290.6

Melting Point:  $-4^\circ\text{C}$ .

Boiling Point:  $210^\circ\text{C}$ . (at 5 mm.)

Specific Gravity: 0.895(20/4)

## OCTYL ETHER

Synonyms:

dioctyl ether      1-octyloxyoctane  
 di-n-octyl ether

Formula:  $[\text{CH}_3(\text{CH}_2)_6\text{CH}_2]_2\text{O}$

Formula Weight: 242.4

Boiling Point:  $291.8^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.820(0/0)      0.805(17/17)

Solubility:

slightly soluble in water  
 soluble in alcohol      soluble in ether

## OCTYL FORMATE

Synonyms:

formic acid n-octyl ester  
n-octyl formate

Formula:  $\text{HCOO}(\text{CH}_2)_7\text{CH}_3$

Characteristics:

pungent, fruity odor  
 bitter, burning taste  
 peach flavor

Formula Weight: 158.2

Boiling Point:  $198^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.893      0.872(12.5/4)

Refractive Index: 1.414

Uses:

synthetic apricot and peach flavors

Solubility:

insoluble in water  
 soluble in 70% alcohol 2:17,  
 80% alcohol 2:3

## tert-OCTYL MERCAPTAN

Formula:  $C_8H_{17}SH$ 

Characteristics: mercaptan odor

Formula Weight: 146.3

Freezing Point:  $-54$  to  $-48^\circ C$ .Boiling Point:  $159$  to  $165^\circ C$ . (at 760 mm.)Specific Gravity:  $0.8444(20/20)$ Refractive Index:  $1.456$ Viscosity (centipoises):  $0.68$  at  $20^\circ C$ .Flash Point:  $115^\circ F$ . (open)

## Uses:

odorant for natural gas  
 modifier of synthetic rubber  
 polymerization  
 oil additive to petroleum  
 metal pickling inhibitor

## Solubility:

insoluble in water  
 soluble in methanol, ether, acetone,  
 benzene, gasoline, and ethyl acetate

## OCTYL NITRATE

Synonyms: n-octyl nitrateFormula:  $CH_3(CH_2)_7ONO_2$ 

Formula Weight: 175.2

Boiling Point:  $110$  to  $112^\circ C$ . (at 20 mm.)

Specific Gravity:

$0.975(0/4)$                        $0.8419(17/17)$

## OCTYL NITRITE

Synonyms: n-octyl nitriteFormula:  $CH_3(CH_2)_7ONO$ 

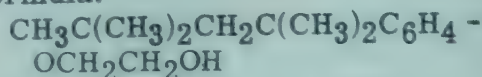
Characteristics: green

Formula Weight: 159.2

Boiling Point:  $174$  to  $177^\circ C$ . (at 760 mm.)Specific Gravity:  $0.862$  at  $17^\circ C$ .

## OCTYLPHENOXYETHANOL

Formula:



Formula Weight: 250.0

Boiling Point:  $160$  to  $210^\circ C$ . (at 5 mm.)Specific Gravity:  $0.985(25/25)$ 

## Uses:

solvent  
 intermediate in the synthesis of  
 insecticides, oil additives,  
 plasticizers, solvents, and  
 synthetic lubricants

## Solubility:

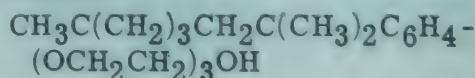
insoluble in water  
 readily miscible with all common  
 organic solvents

## OCTYLPHENOXYDIETHOXYETHANOL

Synonyms:

this is a mixture of alcohols containing  
 chiefly the compound given below

Formula:

Boiling Point:  $199$  to  $255^\circ C$ . (at 3 mm.)Specific Gravity:  $1.025(25/25)$ 

## Uses:

same as for octylphenoxyethanol

## Solubility:

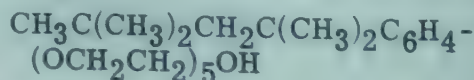
insoluble in water  
 readily miscible with all common  
 organic solvents

## OCTYLPHENOXYTETRA-ETHOXYETHANOL

Synonyms:

this is a mixture of alcohols containing  
 chiefly the compound given below

Formula:

Boiling Point:  $200$  to  $290^\circ C$ . (at 3 mm.)



## 3-OCTYNE (Cont.)

Formula Weight: 110.2

Boiling Point:

133° C. (at 760 mm.)

56.7° C. (at 50 mm.)

Specific Gravity: 0.7501 at 25° C.

Refractive Index: 1.4230 at 25° C.

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## 4-OCTYNE

Synonyms:

dipropylacetylene

4-octine

Formula:  $C_3H_7C:CC_3H_7$ 

Formula Weight: 110.2

Boiling Point:

131° C. (at 760 mm.)

55° C. (at 50 mm.)

Specific Gravity: 0.7474 at 25° C.

Refractive Index: 1.4225 at 25° C.

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

## OLEIC ACID

Synonyms:

9-octadecenoic acid

oleinic acid    red oil

Formula:  $CH_3(CH_2)_7CH:CH(CH_2)_7COOH$ 

Characteristics:

oily    yellow

lard-like odor

darkens when exposed to light

Formula Weight: 282.5

Melting Point: 14° C.

Boiling Point:

360° C. (at 760 mm.)

with decomposition

286° C. (at 100 mm.)

Specific Gravity:

0.854(78/4)

0.895(18/4)

Refractive Index:

1.463 at 17.7° C.

1.4620

Flash Point: 372° F. (closed)

Uses:

oiling of wool

soap stock

oleates

polishing compounds

Solubility:

insoluble in water

soluble in chloroform, benzene, and  
benzine

∞ (in alcohol)

∞ (in ether)

miscible with fixed and volatile oils

Additional Data:

autoignition temperature, 685° F.

acid number, 198.9

## OLEYL ALCOHOL

Synonyms:

cis-9-octadecen-1-olcis-octadecenyl alcoholFormula:  $CH_3(CH_2)_7CH:CH(CH_2)_8OH$ 

Formula Weight: 268.5

Boiling Point: 205 to 210° C. (at 15 mm)

Specific Gravity: 0.8489(20/4)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

## OXALYL CHLORIDE

Synonyms:

ethanedioyl chloride

oxalic acid chloride

Formula:  $ClCOCOC l$ 

Characteristics: fumes

Formula Weight: 126.9

Melting Point: -12° C.

Boiling Point: 63 to 64° C. (at 763 mm)

Specific Gravity: 1.488(13/4)

Refractive Index: 1.43395 at 12.9° C.

ses:  
chlorinating agent in organic syntheses  
olubility:  
decomposed by water, alcohol, and  
alkalies  
soluble in ether      soluble in benzene  
dditional Data: highly toxic

OXETANE  
Synonyms:  
1,3-propylene oxide  
trimethylene oxide  
Formula:  $\text{CH}_2\text{CH}_2\text{CH}_2\text{O}$   
Formula Weight: 58.1  
Boiling Point: 50° C. (at 760 mm.)  
Solubility: ∞ (in water)

P

PALMITYL CHLORIDE

ynonyms:  
hexadecanoyl chloride  
palmitic acid chloride  
palmitoyl chloride  
ormula:  $\text{CH}_3(\text{CH}_2)_{14}\text{COCl}$   
ormula Weight: 274.9  
elting Point: 11 to 12° C.  
oiling Point: 194.5° C. (at 17 mm.)

Refractive Index: 1.40486  
Inflammability Range (volume per cent  
in air): 1.3 (lower limit)  
Flash Point:  
90° F. (open)      78° F. (closed)  
Specific Heat (gram-calories per g.  
per ° C.) (liquid): 0.434  
Uses:  
solvent for fats, gums, oils, resins,  
varnishes, and waxes  
solvent mixtures for cellulose  
derivatives  
dyestuff intermediates, leather tanning,  
medicines, rubber accelerators and  
antioxodants, substitute for acet-  
aldehyde, synthetic organic chemicals

olubility:  
decomposes in water  
decomposes in alcohol  
very soluble in ether

PARALDEHYDE

nonyms:  
paraacetaldehyde    paracetaldehyde  
2,4,6-trimethyl-1,3,5-trioxane  
ormula:  $\text{OCH}(\text{CH}_3)\text{OCH}(\text{CH}_3)\text{OCHCH}_3$   
aracteristics: pleasant odor  
ormula Weight: 132.2  
elting Point: 10.5 to 12.6° C.  
iling Point: 124.4° C. (at 752 mm.)

Solubility (grams per 100 ml.):  
5.88 at 100° C.  
12 at 13° C. (in water)  
∞ (in alcohol)      ∞ (in chloroform)  
∞ (in ether)      ∞ (in oils)  
miscible with most organic solvents  
Additional Data:  
autoignition temperature, 466° F.  
vapor density, 4.55

pecific Gravity:  
0.9960(20/20)      0.9943(20/4)  
8.29 lbs. per gal. at 20° C.

*a*-PARVOLINE

Synonyms:  
2-ethyl-3,5-dimethylpyridine

$\alpha$ -PARVOLINE (Cont.)

Formula:  $C_9H_{13}N$

Formula Weight: 135.2

Boiling Point: 128° C. (at 760 mm.)

Specific Gravity: 0.9338 at 0° C.

Solubility:

slightly soluble in water  
soluble in alcohol

$\beta$ -PARVOLINE

Synonyms:

parvuline  
tetramethylpyridine

Formula:  $C_5H(CH_3)_4N$

Formula Weight: 135.2

Boiling Point: 220° C. (at 760 mm.)

Specific Gravity: 0.916

PELARGONALDEHYDE

Synonyms:

nonanal                      nonylaldehyde  
pelargonic acid aldehyde

Formula:  $CH_3(CH_2)_7CHO$

Characteristics:

rose-like odor with a penetrating  
citronella shade  
waxy flavor

Formula Weight: 142.2

Boiling Point: 185 to 190° C. (at 760 mm.)

Specific Gravity: 0.827(19/19)

Uses:

synthetic cinnamon, ginger, lemon,  
rose, tangerine perfumes  
synthetic lemon and rose flavors

Solubility:

insoluble in water  
very soluble in alcohol  
40 grams per 100 grams of 70%  
alcohol  
slightly soluble in glycerol

PELARGONIC ACID

Synonyms:

nonanoic acid                      n-nonylic acid  
nonoic acid

Formula:  $CH_3(CH_2)_7COOH$

Characteristics:

yellow                      oily

Formula Weight: 158.2

Melting Point: 11 to 12.5° C.

Boiling Point: 253 to 254° C. (at 760 mm)

Specific Gravity: 0.9055(20/4)

Refractive Index: 1.4330

Uses:

hydrotropic salts              organic syntheses  
lacquers                      plastics

Solubility:

very slightly soluble in water  
soluble in alcohol, ether, and  
chloroform  
soluble in common organic solvents

PELARGONYL CHLORIDE

Synonyms:

nonanoyl chloride  
pelargonic acid chloride

Formula:  $CH_3(CH_2)_7COCl$

Characteristics:

colorless to pale yellow

Formula Weight: 176.7

Melting Point: -60.5° C.

Boiling Point:

215.35° C. (at 760 mm.)  
108 to 110° C. (at 22 mm.)  
188 to 218° C. (at 760 mm.)

Specific Gravity:

0.9590(0/4)                      0.946(20/4)

Refractive Index: 1.4380 at 15° C.

Uses:

organic synthesis of plasticizers

## Solubility:

decomposes in water  
decomposes in alcohol  
soluble in ether

## PENT-ACETATE

## Synonyms:

this is a commercial mixture of  
isomeric amyl acetates and amyl  
alcohol obtained by the esterification  
of acetic acid with Pentasol  
these compounds are present:

## Formula:

$\text{CH}_3\text{COO}(\text{CH}_2)_4\text{CH}_3$   
 $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$   
 $\text{CH}_3\text{COOCH}_2\text{CH}(\text{CH}_3)\text{C}_2\text{H}_5$   
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{OOCCH}_3$   
 $(\text{C}_2\text{H}_5)_2\text{CHOOCCH}_3$   
 $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$   
 $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$   
 $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$

Boiling Point: 126 to 155° C. (at 760 mm.)

## Specific Gravity:

0.86 to 0.87(20/20) 7.2 lbs. per gal.

Vapor Pressure (mm. Hg): 9 at 30° C.

Refractive Index: 1.401

## Viscosity (centipoises):

0.683 at 40° C. 3.464 at -40° C.

Flash Point: 107° F. (open)

Specific Heat (gram-calories per g.  
per ° C.) (liquid): 0.491

Heat of Vaporization (gram-calories  
per g.): 68.5

## Uses:

solvent  
nitrocellulose lacquers  
penicillin extractant

Solubility (grams per 100 ml.):

1.0 (of water) 1.5 (in water)

## Additional Data:

water azeotrope:  
boiling point, 92 to 95° C.,

67% pent-acetate  
coefficient of expansion,  
0.00110 at 10 to 35° C.

## dilution ratios

(basis: 8% solid) at 70° F.,  
with toluene. . . . .2.1  
with petroleum naphtha . . . .1.3  
with xylene . . . . .2.4  
with 50% toluene  
50% naphtha . . . . .1.9

## PENTACHLOROETHANE

Synonyms: pentalin

Formula:  $\text{CHCl}_2\text{CCl}_3$

Formula Weight: 202.3

Melting Point: -29.0 to -22° C.

## Boiling Point:

160.5 to 162° C. (at 760 mm.)

## Specific Gravity:

1.709(0/4) 1.6728(25/4)  
1.681(20/4) 1.582 at 25° C.  
14.03 lbs. per gal. at 20° C.

Refractive Index: 1.50250 at 24.0° C.

Viscosity (centipoises): 2.5 at 20° C.

Inflammability Range (volume per cent  
in air)

none (lower limit) none (upper limit)

## Flash Point:

none (closed) none (open)

Specific Heat (gram-calories per g.  
per ° C.) (liquid), 0.27

Heat of Vaporization (gram-calories  
per g.):

55.1 at the boiling point  
44.2 at 147 to 148° C.

## Uses:

solvent for camphor, cellulose acetate  
and ethers, some gums, oils, phos-  
phorus, resins, shellac and sulfur  
acid varnishes, alcohol denaturant,  
dye intermediates, extractant, metal  
degreasing, organic syntheses, soil  
sterilization, substitute for tetra-  
chloroethane

## PENTACHLOROETHANE (Cont.)

Solubility (grams per 100 ml.)

0.03 at 25° C. (of water)

0.05 at 25° C. (in water)

 $\infty$  (in alcohol)  $\infty$  (in ether)

Additional Data:

toxic

weight of pure vapor, 9030 mg./ℓ.

steam distillation point (1 atm.),  
95.8° C.

solvent:

water ratio by weight, 1.8451:1

coefficient of expansion,

0.000912 at 0 to 30° C.

evaporation rate (ether = 100), 3

dielectric constant at 25° C., 3.60

vapor density, 5.69 g./ℓ.

## PENTACHLOROMETHYL ETHER

Formula:  $\text{CCl}_3\text{OCHCl}_2$ 

Characteristics: odor of phosgene

Formula Weight: 218.5

Boiling Point:

158.5 to 159.5° C. (at 760 mm.)

Specific Gravity: 1.64 at 20° C.

Uses: organic syntheses

Solubility: decomposes in hot water

Additional Data: highly irritant

## PENTADECANE

Formula:  $\text{CH}_3(\text{CH}_2)_{13}\text{CH}_3$ 

Formula Weight: 212.4

Melting Point: 10° C.

Boiling Point: 270.5° C. (at 760 mm.)

Specific Gravity: 0.7689(20/4)

Uses: organic syntheses

Solubility:

insoluble in water

very soluble in alcohol

very soluble in ether

## PENTADECYL ACETATE

Synonyms: acetic acid pentadecyl ester

Formula:  $\text{CH}_3\text{COOC}_{15}\text{H}_{31}$ 

Formula Weight: 270.4

Melting Point: 10 to 11° C.

Boiling Point: 230° C. (at 70 mm.)

## 1,2-PENTADIENE

Synonyms: ethylallene

Formula:  $\text{CH}_2:\text{C}:\text{CHCH}_2\text{CH}_3$ 

Formula Weight: 68.1

Boiling Point: 45° C. (at 760 mm.)

Refractive Index: 1.421

Additional Data:

specific gravity of gas (ideal,  
air = 1.0), 2.3515specific gravity of liquid (in vacuo),  
at 20/4° C., 0.692

at 60/60° F., 0.697

API gravity at 60° F., 71.5

liquid density (in vacuo) at 60° F., 5.8coefficient of expansion,  
0.00081 at 60 to 77° F.

## 1,4-PENTADIENE

Formula:  $\text{CH}_2:\text{CHCH}_2\text{CH}:\text{CH}_2$ 

Formula Weight: 68.1

Melting Point: -148° C.

Boiling Point: 25.8 to 26.2° C. (at 760 mm.)

Specific Gravity: 0.6594(20/4)

Refractive Index: 1.3880

Additional Data:

specific gravity of gas (ideal,  
air = 1.0), 2.3515specific gravity of liquid (in vacuo),  
at 20/4° C., 0.660

at 60/60° F., 0.665

API gravity at 60° F., 81.3

liquid density (in vacuo) at 60° F., 5.8coefficient of expansion,  
0.00074 at 60 to 77° F.

specific heat of liquid (Btu./lb./° F.)

at 66.9° F., 0.5144  
 latent heat of vaporization (Btu./lb.)  
 at the boiling point, 164.3  
 total heating values (at 77° F.),  
 20,200 Btu./lb.  
 110,500 Btu./cu. ft. - gas

### 2,3-PENTADIENE

Formula:  $\text{CH}_3\text{CH}:\text{C}:\text{CHCH}_3$   
 Formula Weight: 68.1  
 Boiling Point: 49 to 51° C. (at 760 mm.)  
 Specific Gravity: 0.702(20/0)  
 Refractive Index: 1.39  
 Additional Data:  
 specific gravity of gas (ideal,  
 air = 1.0), 2.3515  
 specific gravity of liquid (in vacuo),  
 at 20/40° C., 0.66 at 60/60° F., 0.66  
 API gravity at 60° F., 83  
 liquid density (in vacuo) at 60° F., 5.5

### PENTAETHYLBENZENE

Formula:  $(\text{C}_2\text{H}_5)_5\text{C}_6\text{H}$   
 Formula Weight: 218.4  
 Melting Point: < -20° C.  
 Boiling Point: 277° C. (at 760 mm.)  
 Vapor Pressure (mm. Hg): 7 at 20° C.  
 Specific Gravity: 0.896(20/4)  
 Refractive Index: 1.516  
 Solubility: insoluble in water

### PENTALARM

Synonyms:  
 a commercial product containing at  
 least 90% of amyl mercaptan  
 Characteristics:  
 red  
 unpleasant but not nauseating odor  
 Boiling Point:  
 100 to 140° C. (not less than 95%)  
 Specific Gravity:  
 0.83 to 0.85(20/20) 7.00 lbs. per gal.

Flash Point: 65° F. (open)  
 Heat of Vaporization (Btu./lb.): 144  
 Uses: fuel gas warning agent  
 Solubility:  
 insoluble in water  
 soluble in methanol, ether, acetone,  
 benzene, and gasoline  
 Additional Data:  
 specific gravity of saturated vapor  
 at 0° C., 3.58  
 coefficient of cubical expansion,  
 0.000573 per ° F. 0.00103 per ° C.

### PENTANE

Synonyms:  
 amyl hydride n-pentane  
 Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$   
 Characteristics: pleasant odor  
 Formula Weight: 72.2  
 Melting Point: -131.5 to -129.9° C.  
 Boiling Point:  
 34 to 36.3° C. (at 760 mm.)  
 33 to 40.6° C. (at 760 mm.)  
 Specific Gravity:  
 0.6214(25/4) 0.630(18/4)  
 0.626(20/4)  
 Refractive Index:  
 1.35748 at 20° C. 1.3570 at 15.7° C.  
 Inflammability Range (volume per cent  
 in air):  
 1.4 (lower limit) 7.8 (upper limit)  
 Flash Point: < -40° F. (closed)  
 Uses:  
 anesthetic organic syntheses  
 artificial ice refrigerant  
 low temperature thermometers  
 lubricant for Claude liquid air machine  
 Solubility (grams per 100 ml.):  
 0.036 at 16° C. (in water)  
 ∞ (in alcohol) ∞ (in ether)  
 soluble in hydrocarbons and oils

## PENTANE (Cont.)

## Additional Data:

specific gravity of gas (ideal,  
air = 1.0), 2.4907  
specific gravity of liquid (in vacuo),  
at 20/40°C., 0.62624  
at 60/60°F., 0.63116  
API gravity at 60°F., 92.7  
liquid density (in vacuo) at 60°F.,  
5.2621  
coefficient of expansion,  
0.00079 at 32 to 68°F.  
specific heat of liquid (Btu./lb./°F.)  
at 62.4°F., 0.557  
latent heat of vaporization (Btu./lb.)  
153.59 at the boiling point  
total heating values (at 77°F.),  
20,914 Btu./lb.  
108,450 Btu./cu. ft. - gas  
weight of pure vapor, 3200 mg./ℓ.  
vapor density, 2.48  
autoignition temperature, 588°F.  
aniline point, 159.3°F.  
critical temperature, 197.2°C.  
critical pressure, 33.0 atm.  
octane number,  
motor 61.9                  research 61.7

## 1, 5-PENTANEDINITRILE

## Synonyms:

glutaronitrile  
trimethylene cyanide  
trimethylene dicyanide

Formula:  $\text{CN}(\text{CH}_2)_3\text{CN}$ 

Formula Weight: 94.1

Melting Point: -29°C.

Boiling Point:

285 to 287.4°C. (at 760 mm.)

Specific Gravity:

0.989 at 25°C.                  0.995(15/4)

Refractive Index: 1.4365 at 23.2°C.

Solubility:

soluble in water                  insoluble in ether  
soluble in alcohol

## 1, 2-PENTANEDIOL

Synonyms:  $\alpha$ -n-amylene glycolFormula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHOHCH}_2\text{OH}$ 

Formula Weight: 104.2

Boiling Point: 211.8°C. (at 760 mm.)

Specific Gravity: 0.980(20/20)

Solubility:

$\infty$  (in water)                   $\infty$  (in ether)  
 $\infty$  (in alcohol)

## 1, 4-PENTANEDIOL

Synonyms:  $\gamma$ -pentylene glycolFormula:  $\text{CH}_3\text{CHOHCH}_2\text{CH}_2\text{CH}_2\text{OH}$ 

Characteristics: oily

Formula Weight: 104.2

Boiling Point: 131 to 133°C. (at 18 mm.)

Specific Gravity:

0.996(17/4)                  0.9954(18/18)

Solubility:

$\infty$  (in water)                   $\infty$  (in chloroform)  
 $\infty$  (in alcohol)                  insoluble in ligroin  
very slightly soluble in ether

## 1, 5-PENTANEDIOL

Synonyms: pentamethylene glycol

Formula:  $\text{CH}_2\text{OHCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ 

Characteristics:

viscous  
burning bitter taste

Formula Weight: 104.2

Boiling Point: 239.4°C. (at 760 mm.)

Specific Gravity:

0.994(20/20)                  0.9938(20/4)

Refractive Index: 1.4499

Flash Point: &gt;80°F. (open)

Uses: organic syntheses

$\infty$  (in water)                       $\infty$  (in alcohol)  
 very soluble in methanol, acetone, and  
 ethyl acetate  
 slightly soluble in ether  
 insoluble in benzene, dichloromethane,  
 heptane, trichloroethylene, and  
 petroleum ether

$\beta$ -n-amylene glycol  
methylethylethylene glycol

solvent for cellulose acetate  
organic syntheses

miscible with most organic solvents

turns brown in the light

 $\infty$  (in ether)

Refractive Index: 1.439 at 25° C.

Formula Weight: 104.2

## 3-PENTANETHIOL (Cont.)

Boiling Point: 105° C. (at 760 mm.)

## Solubility:

insoluble in water    ∞ (in alcohol)  
                                  ∞ (in ether)

## 2-PENTANOL

## Synonyms:

sec-act-amyl alcohol  
 1-methyl-1-butanol  
 methylpropylcarbinol  
 pentan-2-ol

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHOHCH}_3$ 

Formula Weight: 88.2

## Boiling Point:

118.5 to 119.3° C. (at 760 mm.)

## Specific Gravity:

0.810(20/20)                      0.809(20/4)  
 6.76 lbs. per gal. at 20° C.

Refractive Index: 1.4053

Flash Point: 93° F. (closed)

Uses: lacquer solvent

## Solubility (grams per 100 ml.):

10.8 at 20° C. (of water)  
 5.3 at 20° C. (in water)  
 ∞ (in alcohol)                      ∞ (in ether)

## Additional Data:

vapor density, 3.04  
 autoignition temperature, 650 to 725° F.  
 azeotrope with water:  
   boiling point, 91.7° C.  
   weight per cent alcohol, 63.5

## 3-PENTANOL

## Synonyms:

sec-n-amyl alcohol  
 diethylcarbinol  
 1-ethyl-1-propanol

Formula:  $\text{CH}_3\text{CH}_2\text{CHOHCH}_2\text{CH}_3$ 

Formula Weight: 88.2

Freezing Point: &lt; -75° C.

Boiling Point: 115.6° C. (at 760 mm.)

## Specific Gravity:

0.816(20/4)                      0.815(25/4)  
 6.81 lbs. per gal. at 20° C.

## Refractive Index:

1.41 at 20° C.                      1.4077 at 25° C.

## Viscosity (centipoises):

4.12 at 25° C.                      1.09 at 60° C.

Flash Point: 102° F. (open)

Heat of Vaporization (gram-calories per g.): 96.8

## Uses:

concentration of non-ferrous ores  
 syntheses of pharmaceuticals, and  
 flotation agents  
 solvent in manufacture of cellulose  
 esters and ethers  
 lacquers and varnishes

## Solubility (grams per 100 ml.):

5.3 at 30° C. (in water)  
 very soluble in alcohol and ether  
 soluble in methanol, acetone, benzene,  
 gasoline, and ethyl acetate

## Additional Data:

coefficient of expansion,  
 0.00149 per ° C.

## 2-PENTANONE

## Synonyms:

methyl propyl ketone  
 pentanone-2

Formula:  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3$ 

Formula Weight: 86.1

Melting Point: -83.5 to -77.8° C.

## Boiling Point:

101.7 to 103.3° C. (at 760 mm.)  
 101 to 107° C. (at 760 mm.)

## Specific Gravity:

0.8064(20/4)                      0.812(15/15)  
 6.72 lbs. per gal. at 20° C.

## Refractive Index:

1.3895 at 20° C.                      1.38946 at 20.2° C.

Inflammability Range (volume per cent in air):

1.55 (lower limit)                      8.15 (upper limit)

Flash Point:

45° F. (closed)  
55° F., 60° F. (open)

Solubility (grams per 100 ml.):

3.6 at 25° C. (of water)  
6 at 25° C. (in water)  
∞ (in alcohol)            ∞ (in ether)

Additional Data:

azeotrope with water:  
boiling point, 83.3° C.  
weight per cent ketone, 80.5  
coefficient of expansion,  
0.00111 at 10 to 30° C.  
vapor density, 2.96  
dilution ratios:  
with toluene. . . . . 4.0  
with petroleum naphtha . . . . 1.0

2-PENTANONE OXIME

Synonyms: methyl propyl ketoxime

Formula: CH<sub>3</sub>C(:NOH)CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>

Characteristics: oily

Formula Weight: 101.2

Boiling Point: 168° C. (at 760 mm.)

Specific Gravity:  
0.910(20/4)            0.909

Refractive Index: 1.4450

Solubility:  
soluble in water            ∞ (in alcohol)  
   ∞ (in ether)

3-PENTANONE

Synonyms:

sym-dimethylacetone  
diethyl ketone            metacetone  
ethyl ketone            propione  
ethyl propionyl

Formula: C<sub>2</sub>H<sub>5</sub>COC<sub>2</sub>H<sub>5</sub>

Formula Weight: 86.1

Melting Point: -42° C.

Boiling Point: 102.7° C. (at 760 mm.)

Specific Gravity: 0.8159(19/4)

Refractive Index: 1.3939 at 16.6° C.

Uses:

medicines            organic syntheses

Solubility (grams per 100 ml.):

4.7 at 20° C., 3.8 at 100° C. (in water)  
∞ (in alcohol)            ∞ (in ether)

PENTASOL

Synonyms:

this is a commercial product contain-  
ing chiefly 1-pentanol, 3-methyl-1-  
butanol, and 2-methyl-1-butanol  
together with smaller amounts of  
2-pentanol and 3-pentanol

Boiling Point: 112 to 140° C. (at 760 mm.)

Specific Gravity:  
0.81 to 0.82(20/20)  
6.79 lbs. per gal. at 20° C.

Refractive Index: 1.409

Surface Tension (dynes per cm.): 37.7

Viscosity (centipoises):  
4.3 at 20° C.            1.3 at 60° C.  
2.2 at 40° C.

Flash Point: 113° F. (open)

Specific Heat (gram-calories per g.  
per ° C.) (liquid): 0.725

Heat of Vaporization (gram-calories  
per g.): 99.4

Uses:

antifoaming agent    organic syntheses  
concentration of non-ferrous ores  
hydraulic fluid formulations  
solvent for nitrocellulose lacquers,  
many organic compounds, urea-  
formaldehyde resins, and alkyd  
resins

Solubility (ml. per 100 ml.):

8.4 (of water)            3 (in water)  
soluble in methanol, ether, acetone,  
benzene, gasoline, and ethyl acetate

## PENTASOL (Cont.)

## Additional Data:

fire point (open cup), 113° F.  
 water azeotrope:  
 boiling point, 91 to 95° C.,  
 contains approximately 63.8%  
 of Pentasol

## Evaporation Rate at 114.8° F.

%	Minutes
25	4.6
50	9.25
75	14.60
100	22.75

## 1-PENTENE

## Synonyms:

$\alpha$ -n-amylene          propylethylene

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}:\text{CH}_3$

Formula Weight: 70.1

Melting Point: -138° C.

## Boiling Point:

39 to 40° C. (at 760 mm.)  
 30.1° C. (at 760 mm.)  
 32 to 37° C. (at 760 mm.)  
 31° C. (at 760 mm.)

## Specific Gravity:

0.6454(25/4)          0.6410(20/4)

Refractive Index: 1.3714

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)  
 very soluble in dilute sulfuric acid

## Additional Data:

specific gravity of gas  
 (ideal; air = 1.0), 2.4211  
 specific gravity of liquid (in vacuo),  
 at 60/60° F., 0.6461

API gravity, °API at 60° F., 87.5  
 liquid density (in vacuo) at 60° F.,  
 5.387 lbs./gal.

total heating values (at 77° F.),  
 20,560 Btu./lb.

109,100 Btu./cu. ft. - gas

aniline point, 66.2° F.

critical temperature, 394° F.

critical pressure, 594 psia.

coefficient of expansion,

0.00088 at 60 to 77° F.

latent heat of vaporization (Btu./lb.),

135.0 at 54.5° F.

## 2-PENTENE

## Synonyms:

$\beta$ -n-amylene

sym-methylethylethylene

Formula:  $\text{CH}_3\text{CH}_2\text{CH}:\text{CHCH}_3$

Formula Weight: 70.1

Melting Point: -139° C.

Boiling Point: 36.4° C. (at 760 mm.)

## Specific Gravity:

0.651                      0.650(20/4)

Inflammability Range (volume per cent  
 in air): 1.6 (lower limit)

Specific Heat (Btu./lb. at 60° F.) (liquid)  
 0.515

## Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                   $\infty$  (in ether)  
 very soluble in dilute sulfuric acid

## Additional Data:

vapor density, 2.42  
 aniline point, 64.9° F.  
 critical temperature, 396° F.  
 critical pressure, 594 psia.  
 coefficient of expansion,  
 0.00087 at 60 to 77° F.

	<u>cis-2-Pentene</u> 37° C.	<u>trans-2-Pentene</u> 36.5° C.
boiling point (1 atm.)		-140° C.
freezing point in air (1 atm.)		
specific gravity of gas (ideal; air = 1.0)	2.4211	2.4211
of liquid } at 20/40° C.	0.656	0.6482
in vacuo } at 60/60° F.	0.661	0.6533
API gravity; ° API at 60° F.	82.6	85.1
liquid density (in vacuo at 60° F.) lbs./gal.	5.51	5.447
refractive index	1.3820	1.3793
total heating values (at 77° F.)		
Btu./lb.	20390	20390
Btu./cu. ft. - gas	110700	109400

## 4-PENTENENITRILE

Synonyms:

allylacetonitrile      allylmethyl cyanide

Formula:  $\text{CH}_2\text{:CHCH}_2\text{CH}_2\text{CN}$ 

Formula Weight: 81.1

Boiling Point: 140° C. (at 760 mm.)

Specific Gravity: 1.18 at 13° C.

Solubility:

insoluble in water     $\infty$  (in alcohol)  
                                  $\infty$  (in ether)

## 2-PENTENOIC ACID

Synonyms:

butenoic acid  
 $\beta$ -ethylacrylic acidFormula:  $\text{C}_2\text{H}_5\text{CH:CHCOOH}$ 

Formula Weight: 100.1

Melting Point: 9 to 10° C.

Boiling Point: 197 to 200° C. (at 760 mm.)

Specific Gravity: 0.992 at 15° C.

Solubility (grams per 100 ml.);  
6.3 at 20° C. (in water)

## 4-PENTENOIC ACID

Synonyms: allylacetic acid

Formula:  $\text{CH}_2\text{:CHCH}_2\text{CH}_2\text{COOH}$ 

Formula Weight: 100.1

Melting Point: &lt; -18° C.

Boiling Point: 187 to 189° C. (at 760 mm.)

Specific Gravity: 0.984(18/4)

Refractive Index: 1.4341 at 7.5° C.

Solubility:

slightly soluble in water  
very soluble in alcohol and ether

## 1-PENTEN-3-OL

Synonyms: ethylvinylcarbinol

Formula:  $\text{CH}_2\text{:CHCHOHC}_2\text{H}_5$ 

Formula Weight: 86.1

Boiling Point: 114 to 115° C. (at 760 mm.)

Specific Gravity:

0.840(20/4)                      0.840(19.5/0)

Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## 3-PENTEN-2-OL

Synonyms: dimethylpropenylcarbinol

Formula:  $\text{C}_6\text{H}_{11}\text{OH}$ 

Formula Weight: 100.2

Boiling Point: 112° C. (at 760 mm.)

Specific Gravity: 0.8347(20/4)

Refractive Index: 1.4302

Solubility (grams per 100 ml.):

10 at 10° C. (in water)  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## 4-PENTEN-1-OL

Synonyms:  $\beta$ -allylethyl alcoholFormula:  $\text{CH}_2\text{:CHCH}_2\text{CH}_2\text{CH}_2\text{OH}$ 

Formula Weight: 86.1

Boiling Point: 140 to 142°C. (at 760 mm.)

Specific Gravity: 0.863(0/4)

## 4-PENTEN-2-OL

Synonyms:

allyl methyl carbinol

allyl methyl methanol

amylene alcohol

methyl allyl carbinol

methyl allyl methanol

Formula:  $\text{CH}_2\text{:CHCH}_2\text{CHOHCH}_3$ 

Formula Weight: 86.1

Boiling Point: 116.4°C. (at 760 mm.)

Specific Gravity: 0.834(20/4)

Solubility (grams per 100 ml.):

12.5 (in water)  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 3-PENTEN-2-ONE

Synonyms:

ethylidene acetone

methyl propenyl ketone

Formula:  $\text{CH}_3\text{CH:CHCOCH}_3$ 

Formula Weight: 84.1

Boiling Point: 122 to 124°C. (at 760 mm.)

Specific Gravity: 0.856 at 20°C.

Refractive Index: 1.43903 at 19.6°C.

Solubility: soluble in water

## 1-PENTYNE

Synonyms:

1-pentene

n-propylacetyleneFormula:  $\text{HC:CCH}_2\text{CH}_2\text{CH}_3$ 

Formula Weight: 68.1

Melting Point: -95°C.

Boiling Point:

40°C. (at 760 mm.)

48 to 49°C. (at 760 mm.)

Specific Gravity:

0.7221 at 0°C.

0.6882(25/4)

Refractive Index: 1.4079 at 18°C.

Solubility:

insoluble in water  $\infty$  (in ether)

very soluble in alcohol

## 2-PENTYNE

Synonyms:

ethylmethylacetylene

2-pentene

valerylene

Formula:  $\text{CH}_3\text{C:CCH}_2\text{CH}_3$ 

Formula Weight: 68.1

Melting Point: -101°C.

Boiling Point: 56°C. (at 760 mm.)

Specific Gravity:

0.687

0.7127(17.2/4)

Refractive Index: 1.40044

Solubility:

insoluble in water  $\infty$  (in ether)

very soluble in alcohol

## PETROLATUM (liquid)

Synonyms:

"Albolene"

paraffin oil

glycolin

white mineral oil

liquid paraffin

this is a commercial petroleum distil-

lation product from which the low  
boiling fractions were removed

Characteristics:

oily

transparent

Boiling Point: 330 to 390°C. (at 760 mm)Specific Gravity: 0.840 to 0.940

Uses:

laxative

medicines

dressing for wounds

## Solubility:

insoluble in water and cold alcohol  
soluble in benzene, boiling alcohol,  
ether, chloroform, carbon disulfide,  
and fixed and volatile oils

## PETROLEUM

## Synonyms:

crude oil	lima oil
earth oil	naphtha
a commercial mixture of numerous liquid hydrocarbons	

## Characteristics:

yellow, red, brown, black  
distinct but varying odor

Specific Gravity: 0.780 to 0.970

Uses: fuel, petroleum distillates

## PETROLEUM ETHER

## Synonyms:

benzine  
benzium purificatum  
canadol  
light ligroin  
petroleum naphtha  
ordinary petroleum ether is a  
commercial mixture of light  
components of petroleum

PETROLEUM ETHER (Cont.)

Grades	Ordinary	A.S.T.M. Grade I	A.S.T.M. Grade II	A.S.T.M. Grade III	Soltrol 100	Soltrol 140	Soltrol 180
Boiling Point (°C.):	40-70	25.6-31.1	33.3-37.8	51.7-79.4	163.9- 184.4	186.7- 206.1	203.9- 248.9
Specific Gravity	0.635-	0.63	0.63	0.67	0.7527	0.7649	0.7800
at 60/60° F.:	0.660						
lbs./gal. at 60° F.:		5.3	5.3	5.6			
Refractive Index:					1.4195	1.4242	1.435
Viscosity (centistokes at 100° F.):					1.26	1.61	
Flash Point (° F.)							
closed:	-50				120	143	
open:							164
Uses:	Solvent for: Fats, Greases, Inks Lacquers, Oils, Paints Rubber Varnishes <u>Detergent Soaps</u> Rubber Cements Perfume Extraction Fuel Illuminant Textile Cleaning and Degreasing				Solvent Insecticides Odorless Paint Dry Cleaning Home Cleaners Chemicals Intermediates Extractions Solvent		
API Gravity, ° API:					56.5	53.5	49.7
Fire Point, ° F.:					135	160	
Color Saybolt:					+28	+26	+30
Sulfur Content, weight %:	— does not exceed 0.005 —				0.0012	0.0011	
Kauri Butanol Number:					25.6	25.4	26.0
Aniline Point:							186
Dimethyl Sulfate Value %:					2	2	
Bromine Number:					1.6	1.2	1
Solubility:	Soluble in alcohol, ether, chloroform, benzene, castor oil, and fixed and volatile oils						
Autoignition							
Temperature:	475° F.						
Vapor Density:	2.50						
Vapor Pressure (psia. abs.):							
70° F.		12.1	8.3	5.1			
100° F.		20.5	15.0	9.5			
130° F.		33.5	25.0	16.6			

**$\alpha$ -PHELLANDRENE**

## Synonyms:

5-isopropyl-2-methyl-1,3-cyclohexadiene  
1,5-menthadiene

Formula:  $C_{10}H_{16}$ 

Formula Weight: 136.2

Boiling Point: 175°C. (at 760 mm.)

Specific Gravity: 0.845 at 20°C.

## Solubility:

insoluble in alcohol soluble in ether

 **$\beta$ -PHELLANDRENE**

## Synonyms:

3-isopropyl-6-methylenecyclohexene  
1(7),2-p-menthadiene

Formula:  $C_{10}H_{16}$ 

Formula Weight: 136.2

Boiling Point: 171 to 172°C. (at 760 mm.)

Specific Gravity: 0.852(20/4)

Refractive Index: 1.4788

## Solubility:

insoluble in water soluble in ether  
insoluble in alcohol

**PHENETHYL ACETATE**

## Synonyms:

benzyl carbinyl acetate  
 $\alpha$ -oxy- $\beta$ -phenylethane acetate  
 $\beta$ -phenylethyl acetate  
phenyl ethyl ether acetate

Formula:  $C_6H_5CH_2CH_2OOCCH_3$ 

## Characteristics:

pronounced fruity apricot and peach-like odor  
sweet insipid taste honey aroma

Formula Weight: 164.2

## Boiling Point:

232 to 233°C. (at 760 mm.)  
226°C. (at 760 mm.)

## Specific Gravity:

1.037 to 1.038      1.031  
1.051 at 22.5°C.

## Uses:

perfumes  
synthetic apple, apricot, honey, malt, orange, peach, and strawberry flavors

## Solubility:

soluble in alcohol      soluble in ether  
1 volume of ester is soluble  
in 1 volume of 80% alcohol

**PHENETHYL ALCOHOL**

## Synonyms:

benzyl carbinol      2-phenylethanol  
 $\beta$ -phenylethyl alcohol

Formula:  $C_6H_5CH_2CH_2OH$ 

## Characteristics:

oily      viscous  
honey-rose odor  
sweet, biting, burning taste

Formula Weight: 122.2

Melting Point: -27°C.

## Boiling Point:

219 to 221°C. (at 760 mm.)  
218°C. (at 760 mm.)  
with slight decomposition

## Specific Gravity:

1.0235(15/4)      1.020 to 1.025  
8.5 lbs. per gal. at 59°F.

## Refractive Index:

1.5240      1.535  
1.524

Flash Point: 216°F. (closed)

## Uses:

perfumery      synthetic rose oil  
soaps  
synthetic currant, gooseberry, hops, peach, plum, tea, and raspberry flavors

## PHENETHYL ALCOHOL (Cont.)

## Solubility (grams per 100 ml.):

1.6 at 20°C. (in water)

 $\infty$  (in alcohol)  $\infty$  (in ether)

miscible with most organic solvents

## Solubility in Water-Alcohol Mixtures

Alcohol %	Ratio
30	1:20
40	1:3
60	1:2
70	1:1
80	miscible

## Additional Data:

hygroscopic

volatile with steam

the hot liquid has a strong peppery odor

the vapors irritate the eyes

vapor density, 4.21

## PHENETHYLAMINE

## Synonyms:

1-amino-2-phenylethane

 $\beta$ -phenylethylamine $\omega$ -phenylethylamineFormula:  $C_6H_5CH_2CH_2NH_2$ 

Formula Weight: 121.2

Boiling Point: 195 to 198°C. (at 760 mm.)

Specific Gravity: 0.958(24/4)

Refractive Index: 1.575

## Solubility:

soluble in water

very soluble in alcohol and ether

## PHENETHYL BENZOATE

## Synonyms:

benzoic acid  $\beta$ -phenethyl ester $\beta$ -phenethyl benzoateFormula:  $C_6H_5COOCH_2CH_2C_6H_5$ 

## Characteristics:

agreeable rose-like odor

bitter taste strawberry flavor

Formula Weight: 226.3

Boiling Point: 204 to 206°C. (at 25 mm.)

Specific Gravity: 1.102 to 1.103

## Uses:

synthetic honey and strawberry flavors

## Solubility:

insoluble in water soluble in alcohol

soluble in ether

one volume of the ester is soluble  
in 18 volumes of 80% alcoholm-PHENETIDINE

## Synonyms:

1-amino-3-ethoxybenzene

m-aminophenetole3- or m-ethoxyanilinem-aminophenylethyl etherFormula:  $C_2H_5OC_6H_4NH_2$ 

## Characteristics:

dark red

toxic

oily

Formula Weight: 137.2

## Boiling Point:

248°C. (at 760 mm.)

180 to 205°C. (at 100 mm.)

## Solubility:

very slightly soluble in water

soluble in alcohol soluble in ether

## Additional Data:

avoid breathing of vapors and contact  
with the skino-PHENETIDINE

## Synonyms:

1-amino-2-ethoxybenzene

o-aminophenetole2- or o-ethoxyanilineo-aminophenylethyl etherFormula:  $C_2H_5OC_6H_4NH_2$ 

Characteristics: oily

Formula Weight: 137.2

Melting Point: &lt; -21°C.

## Boiling Point:

228 to 229°C. (at 760 mm.)

231 to 234°C. (at 760 mm.)

## Uses:

intermediate in the synthesis of dyes

## Solubility:

very slightly soluble in water

soluble in alcohol      soluble in ether

p-PHENETIDINE

## Synonyms:

1-amino-4-ethoxybenzene

p-aminophenetole

4- or p-ethoxyaniline

p-aminophenylethyl ether

Formula:  $C_2H_5OC_6H_4NH_2$

## Characteristics:

yellowish dark red      oily

toxic

mild aniline-like odor

Formula Weight: 137.2

Melting Point: 2.4 to 4°C.

## Boiling Point:

254 to 255°C. (at 760 mm.)

248 to 251°C. (at 760 mm.)

## Specific Gravity:

1.0613 at 15°C.      1.061(25/25)

1.057 to 1.058(25/4)

8.8 lbs. per gal. at 25°C.

Refractive Index: 1.5578 at 25°C.

## Viscosity (centipoises)

10.157 at 25°C.      2.949 at 60°C.

Flash Point: 240.8° F. (closed)

Specific Heat (gram-calories per g.  
per °C.) (liquid): 0.37

## Heat of Vaporization:

828 calories per g.

149 Btu. per lb.

## Uses:

intermediate in the synthesis of dyes

and pharmaceuticals

manufacture of acetphenetidine

## Solubility:

very slightly soluble in water

soluble in alcohol      soluble in ether

miscible with most organic solvents

## Additional Data:

avoid breathing of vapors and contact  
with the skin

fire point, 262.4° F.

## PHENETOLE

## Synonyms:

ethoxybenzene

ethyl phenyl ether

Formula:  $C_2H_5OC_6H_5$

## Characteristics:

refractive

nearly colorless

pleasant, characteristics odor

Formula Weight: 122.2

Melting Point: -30.2°C.

## Boiling Point:

172.0°C. (at 760 mm.)

60°C. (at 9 mm.)

## Specific Gravity:

0.964(25/25)

0.967(20/4)

0.9666(20.2/4)

Refractive Index: 1.5076 at 21°C.

## Viscosity (centipoises):

1.1 at 25°C.

0.6 at 60°C.

Flash Point: 145.4° F. (closed)

## Solubility:

insoluble in water

very soluble in alcohol

∞ (in ether, methanol, benzene, and  
carbon tetrachloride)

## PHENOLSULFONIC ACID

Synonyms: sulfocarboic acid

Formula:  $HOC_6H_4SO_3H$

Characteristics: yellow

Formula Weight: 174.2

Specific Gravity: 1.155 at 15°C.

## Uses:

water analysis

organic syntheses of dyes, inter-  
mediates, drugs, and disinfectants

## Solubility:

soluble in water

soluble in alcohol

PHENOLSULFONIC ACID (Cont.)

Additional Data:

becomes brown on exposure to air

PHENOXY-2-PROPANONE

Synonyms:

$\omega$ -acetoanisole      phenoxyacetone

Formula:  $C_6H_5OCH_2COCH_3$

Characteristics: oily

Formula Weight: 150.2

Boiling Point: 229 to 230° C. (at 760 mm.)

PHENYL ACETATE

Synonyms:

acetic acid phenyl ester  
acetylphenol

Formula:  $CH_3COOC_6H_5$

Characteristics: pleasant odor

Formula Weight: 136.1

Freezing Point: -7° C.

Boiling Point:

196° C. (at 760 mm.)

195.8° C. (at 756 mm.)

Specific Gravity:

1.073(25/25)

1.08(15/15)

9.0 lbs. per gal. at 15° C.

Refractive Index: 1.5002 at 25° C.

Viscosity (centipoises):

2.452 at 25° C.

1.196 at 60° C.

Flash Point: 176° F. (closed)

Specific Heat (gram-calories per g.  
per ° C.) (liquid): 0.30

Heat of Vaporization:

73.6 gram-calories per g.

132 Btu. per lb.

Uses:

organic syntheses      solvent

Solubility:

very slightly soluble in water

$\infty$  (in alcohol, ether, chloroform, and  
carbon tetrachloride)

miscible with most organic solvents

Additional Data: fire point, 185° F.

1-PHENYL-2-BUTANONE

Synonyms:

benzyl ethyl ketone  
ethyl benzyl ketone

Formula:  $C_2H_5COCH_2C_6H_5$

Formula Weight: 148.2

Boiling Point: 230.2° C. (at 760 mm.)

Specific Gravity:

1.002(0/4)

0.998 at 17° C.

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

4-PHENYL-2-BUTANONE

Synonyms: benzylacetone

Formula:  $C_6H_5CH_2CH_2COCH_3$

Formula Weight: 148.2

Boiling Point:

235° C. (at 760 mm.)

115° C. (at 13 mm.)

Specific Gravity: 0.989(23/17)

Solubility:

soluble in alcohol      soluble in ether

1-PHENYL-1-BUTYNE

Synonyms:

1-butylnylbenzene  
ethylphenylacetylene

Formula:  $C_6H_5C:CCH_2CH_3$

Formula Weight: 130.2

Boiling Point: 201 to 203° C. (at 760 mm)

Specific Gravity: 0.923 at 21° C.

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## PHENYL "CELLOSOLVE"

## Synonyms:

ethylene glycol monophenyl ether  
 $\beta$ -hydroxyethyl phenyl ether  
 2-phenoxyethanol  
 phenoxyethyl alcohol

Formula:  $C_6H_5OCH_2CH_2OH$

## Characteristics:

oily  
 faintly aromatic, rose-like odor

Formula Weight: 138.2

Melting Point: 12.5 to 14.0° C.

## Boiling Point:

245.2° C. (at 760 mm.)  
240 to 248° C. (at 760 mm.)  
244.7° C. (at 760 mm.)

## Specific Gravity:

1.1094(20/20)  
1.1060 to 1.1110(20/20)  
9.23 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg): 0.03 at 20° C.

Refractive Index: 1.5386

Surface Tension (dynes per cm.):  
45.6 at 25° C.

Viscosity (centipoises): 30.5 at 20° C.

Flash Point: 250° F. (open)

## Uses:

solvent for cellulose acetate and  
 nitrate, ethyl cellulose, oils, Vinylite,  
 vinyl acetate resin AYAF, ester gum,  
 dewaxed dammar, rosin, linseed oil,  
 various phenolic and alkyd resins,  
 dyes, and inks  
 synthesis of organic chemicals,  
 germicides, perfumes, pharmaceuti-  
 cals, and plasticizers  
 perfume fixative for soaps and  
 cosmetics

Solubility (per cent by weight):

10.8 at 20° C. (of water)

2.7 at 20° C. (in water)

very soluble in alcohol

soluble in ether, benzene, and

potassium hydroxide solution

## PHENYLCYCLOHEXANE

## Synonyms:

cyclohexylbenzene  
 1,2,3,4,5,6-hexahydrobiphenyl

Formula:  $C_6H_5C_6H_{11}$

## Characteristics:

oily aromatic odor

Formula Weight: 160.3

## Melting Point:

7 to 8° C. 4.8° C.

## Boiling Point:

238 to 241° C. (at 760 mm.)  
237.5° C. (at 760 mm.)

## Specific Gravity:

0.9440(20/4) 0.937(25/25)  
0.935(25/15.6)  
7.78 lbs. per gal. at 25° C.

Refractive Index: 1.5205 at 25° C.

Viscosity (in S.U.S.): 31.2 at 100° F.

Flash Point: 210° F. (closed)

## Uses:

dielectric organic syntheses  
 high boiling solvent plasticizer

## Solubility:

insoluble in water  
 very soluble in alcohol and ether  
 soluble in common organic solvents

## Additional Data:

resistivity at 100° C.,  
 $11.410 \times 10^9$  ohms/cc.  
 flame point, 220° F.

## PHENYL DI-o-XENYL PHOSPHATE

Synonyms: Phosphen-6

Formula:  $(C_{12}H_9O)_2POOC_6H_5$

## Characteristics:

clear, colorless, viscous liquid

Formula Weight: 478.5

Boiling Point: 285 to 330° C. (at 760 mm.)

Specific Gravity: 1.20(60/4)

Flash Point: 482° F.

## PHENYL DI-o-XENYL PHOSPHATE

(Cont.)

## Solubility:

insoluble in water  
 very soluble in alcohol  
 $\infty$  (in benzene and carbon tetra-  
 chloride)  
 soluble in V.M.P. naphtha

## 1-PHENYL-1-HEPTANOL

## Synonyms:

n-hexylphenylcarbinol  
d-phenyl n-heptyl alcohol

Formula:  $C_6H_{13}CHOHC_6H_5$ 

Formula Weight: 192.3

Boiling Point: 275° C. (at 760 mm.)

Specific Gravity: 0.946

## PHENYLHYDRAZINE

Formula:  $C_6H_5NHNH_2$ 

## Characteristics:

pale yellow                      toxic  
 characteristic odor

Formula Weight: 108.1

Melting Point: 19.6° C.

## Boiling Point:

243.5° C. (at 760 mm.)  
 with slight decomposition

## Specific Gravity:

1.0978(20/4)                      1.097(25/25)  
 9.13 lbs. per gal. at 25° C.

## Viscosity (centipoises):

13.256 at 25° C.                      3.340 at 60° C.

Flash Point: 192.2° F. (closed)

Specific Heat (gram-calories per g.  
 per °C.) (liquid): 0.39

## Heat of Vaporization:

102.9 gram-calories per g.  
 185 Btu. per lb.

## Uses:

analytical reagent  
 synthesis of dyes and pharmaceuticals

## Solubility (grams per 100 ml.):

12.6 at 20° C., 23 at 50° C. (in water)  
 $\infty$  (in alcohol)                       $\infty$  (in chloroform)  
 $\infty$  (in ether)                       $\infty$  (in benzene)

## Additional Data:

becomes red when exposed to light  
 fire point, 222.8° F.

## PHENYL ISOCYANATE

## Synonyms:

carbanil  
 isocyanic acid phenyl ester  
 phenyl carbonimide

Formula:  $C_6H_5NCO$ 

Formula Weight: 119.1

Boiling Point: 165.6° C. (at 760 mm.)

Specific Gravity: 1.095(20/4)

Refractive Index: 1.53684 at 19.6° C.

## Solubility:

decomposed by water and alcohol  
 very soluble in ether

## PHENYL ISOCYANIDE

## Synonyms: phenylcarbylamine

Formula:  $C_6H_5NC$ 

Characteristics: colorless to green

Formula Weight: 103.1

## Boiling Point:

166° C. (at 760 mm.)  
 with decomposition  
 78° C. (at 40 mm.)

Specific Gravity: 0.9775 at 15° C.

## Solubility:

decomposed by water and alcohol  
 soluble in ether

## PHENYL ISOTHIOCYANATE

## Synonyms:

isothiocyanic acid phenyl ester  
 phenyl mustard oil  
 phenyl thiocarbimide  
 phenyl thiocarbonimide  
 thiocarbanil

Formula:  $C_6H_5NCS$

Formula Weight: 135.2

Melting Point:  $-21^{\circ}C$ .

Boiling Point:

218.5 to  $220^{\circ}C$ . (at 760 mm.)

Specific Gravity:

1.135(16/4) 1.138(15/15)

1.1297(24/4)

Refractive Index: 1.64918 at  $23.4^{\circ}C$ .

Solubility:

insoluble in water soluble in alcohol

soluble in ether

### 1-PHENYL-1,4-PENTANEDIONE

Synonyms:

$\alpha$ -acetylacetophenone

acetophenoneacetone

$\beta$ -acetylpropiophenone

phenacylacetone

$\gamma$ -oxo-(or  $\gamma$ -keto-)valerophenone

Formula:  $C_6H_5COCH_2CH_2COCH_3$

Characteristics:

yellow oily

Formula Weight: 176.2

Boiling Point:

$162^{\circ}C$ . (at 12 mm.) with decomposition

Specific Gravity:  $>1$

Solubility:

slightly soluble in cold water

insoluble in alkalis

### PHENYLPHOSPHINE

Formula:  $C_6H_5PH_2$

Formula Weight: 110.1

Boiling Point:  $160$  to  $161^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.001 at  $15^{\circ}C$ .

### 1-PHENYL-1-PROPANOL

Synonyms:

ethylphenylcarbinol

sec-phenyl propyl alcohol

Formula:  $C_2H_5CHOHC_6H_5$

Formula Weight: 136.2

Boiling Point:

$212$  to  $220^{\circ}C$ . (at 760 mm.)

with decomposition

Specific Gravity:

0.994(23/20) 0.9962(17/4)

Solubility:

insoluble in water soluble in alcohol

soluble in ether

### 3-PHENYL-1-PROPANOL

Synonyms:

hydrocinnamyl alcohol

$\gamma$ -phenyl propyl alcohol

Formula:  $C_6H_5CH_2CH_2CH_2OH$

Formula Weight: 136.2

Melting Point:  $<-18^{\circ}C$ .

Boiling Point:

$235$  to  $237^{\circ}C$ . (at 760 mm.)

$235.6^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.008

Refractive Index: 1.53565

Solubility:

soluble in water  $\infty$  (in alcohol)

$\infty$  (in ether)

### PHENYL PROPIONATE

Synonyms:

propionic acid phenyl ester

Formula:  $C_2H_5COOC_6H_5$

Formula Weight: 150.2

Melting Point:  $20^{\circ}C$ .

Boiling Point:  $211^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.047(25/25)

### PHENYL PROPYL ETHER

Synonyms: propoxybenzene

Formula:  $C_3H_7OC_6H_5$

Formula Weight: 136.2

## PHENYL PROPYL ETHER (Cont.)

## Boiling Point:

189 to 190.5° C. (at 760 mm.)

Specific Gravity: 0.9530(15/15)

## Solubility:

soluble in alcohol    soluble in ether

## 2-PHENYLPYRIDINE

Formula:  $C_6H_5C_5H_4N$ 

Formula Weight: 155.2

## Boiling Point:

270° C. (at 760 mm.)

269 to 270° C. (at 745 mm.)

Specific Gravity: &gt;1

## Solubility:

insoluble in water

very soluble in alcohol and ether

## 3-PHENYLPYRIDINE

Formula:  $C_6H_5C_5H_4N$ 

Characteristics: oily

Formula Weight: 155.2

## Boiling Point:

270.4° C. (at 760 mm.)

269 to 270° C. (at 749 mm.)

Specific Gravity: &gt;1

## Solubility:

insoluble in water

very soluble in alcohol and ether

## 8-PHENYLQUINOLINE

Formula:  $C_6H_5C_9H_6N$ 

## Characteristics:

viscous

fluorescent

oily

Formula Weight: 205.3

Boiling Point: 283° C. (at 187 mm.)

## Solubility:

soluble in alcohol, ether, and benzene

## PHENYL SULFIDE

## Synonyms:

benzene sulfide    diphenyl sulfide  
phenylthiobenzeneFormula:  $(C_6H_5)_2S$ 

Formula Weight: 186.3

Melting Point: &lt;-40° C.

## Boiling Point:

292.5 to 297° C. (at 760 mm.)

Specific Gravity: 1.1185(15/15)

Refractive Index: 1.635 at 18° C.

## Solubility:

insoluble in water    soluble in alcohol  
∞ (in ether, carbon disulfide, and  
benzene)

## PHTHALYL CHLORIDE

## Synonyms:

sym-phthalic acid (di)chloride  
phthalyl dichlorideFormula:  $C_6H_4(COCl)_2$ 

Characteristics: yellow

Formula Weight: 203.0

Melting Point: 16° C.

Boiling Point: 281.1° C. (at 760 mm.)

Specific Gravity: 1.414(25/25)

## Uses:

plasticizers

resins

## Solubility:

decomposed by water and alcohol  
soluble in ether

## PHYTADIENE

Formula:  $C_{20}H_{38}$ 

Formula Weight: 278.5

Boiling Point: 185 to 188° C. (at 22 mm.)

Specific Gravity: 0.826(0/4)

## Solubility:

∞ (in methanol, acetic acid, and  
petroleum ether)

## PHYTANE

Formula:  $C_{20}H_{42}$ 

Formula Weight: 282.5

Boiling Point:  $169.5^{\circ}C$ . (at 9.5 mm.)

Specific Gravity: 0.803(0/4)

Solubility:

very slightly soluble in alcohol

## PHYTANOL

Synonyms: dihydrophytol

Formula:  $C_{20}H_{41}OH$ 

Characteristics: oily

Formula Weight: 298.5

Boiling Point:  $202^{\circ}C$ . (at 10 mm.)

Specific Gravity: 0.840(20/4)

Solubility:

insoluble in water	soluble in alcohol
	soluble in ether

## PHYTENE

Formula:  $C_{20}H_{40}$ 

Characteristics: oily

Formula Weight: 280.5

Boiling Point:

 $177$  to  $178^{\circ}C$ . (at 10.5 mm.)

Specific Gravity: 0.817(0/4)

Solubility:

slightly soluble in hot alcohol  
 slightly soluble in ether  
 very soluble in petroleum ether

## PHYTOL

Synonyms:

3,7,11,15-tetramethyl-2-hexadecen-1-ol

Formula:  $C_{20}H_{39}OH$ 

Characteristics: oily

Formula Weight: 296.5

Boiling Point:  $204^{\circ}C$ . (at 10 mm.)

Specific Gravity:

0.864(0/4)      0.852(20/4)

Refractive Index: 1.46380

Solubility:

insoluble in water	$\infty$ (in ether)
$\infty$ (in alcohol)	$\infty$ (in methanol)

## 2-PICOLINE

Synonyms:

2-methylpyridine       $\alpha$ -picolineFormula:  $CH_3C_6H_4N$ 

Formula Weight: 93.1

Melting Point:  $-69.9^{\circ}C$ .

Boiling Point:

 $128$  to  $131^{\circ}C$ . (at 760 mm.) $128.8^{\circ}C$ . (at 760 mm.) $129.3^{\circ}C$ . (at 760 mm.)

Specific Gravity:

0.952      0.950(15/4)

7.90 lbs. per gal.Refractive Index: 1.50293 at  $16.7^{\circ}C$ .

Uses:

syntheses of anesthetics, dyes,  
 insecticides, rubber accelerators,  
 pharmaceuticals, and resins

Solubility:

very soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)  
 soluble in most common organic  
 solvents including alcohols, esters,  
 ethers, ketones, and aliphatic and  
 aromatic hydrocarbons

## 3-PICOLINE

Synonyms:

3-methylpyridine       $\beta$ -picolineFormula:  $CH_3C_6H_4N$ 

Formula Weight: 93.1

Boiling Point:

 $143.5^{\circ}C$ . (at 760 mm.) $144.2^{\circ}C$ . (at 760 mm.)

Specific Gravity:

0.9613(15/4)      8.01 lbs. per gal.

## 3-PICOLINE (Cont.)

Refractive Index: 1.50432 at 24.0° C.

## Uses:

synthesis of dyes, insecticides,  
nicotinic acid, pharmaceuticals,  
resins, and rubber accelerators

## Solubility:

∞ (in water, alcohol and ether)  
soluble in most common organic  
solvents including alcohols, esters,  
ethers, ketones, and aliphatic and  
aromatic hydrocarbons

## 4-PICOLINE

## Synonyms:

4-methylpyridine    γ-picoline

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{N}$ 

Formula Weight: 93.1

Freezing Point: 1.5° C.

## Boiling Point:

143.1° C. (at 760 mm.)

145.4° C. (at 760 mm.)

## Specific Gravity:

0.9571(15/4)    8.01 lbs. per gal.

## Uses:

synthesis of dyes, insecticides,  
pharmaceuticals, resins, and rubber  
accelerators

## Solubility:

∞ (in water, alcohol and ether)  
soluble in most common organic  
solvents including alcohols, esters,  
ethers, ketones, and aliphatic and  
aromatic hydrocarbons

## PICOLINES (mixed)

## Synonyms:

3,4-methylpyridine

β, γ-picolene

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{N}$ 

Formula Weight: 93.1

Boiling Point: 140 to 145° C. (at 760 mm.)Specific Gravity: 8.0 lbs. per gal.

## Uses:

waterproofing agent for textiles

## Solubility:

∞ (in water)    ∞ (in ether)  
∞ (in alcohol)

## PIMELIC ACID NITRILE

Formula:  $(\text{C}_2\text{H}_5)_2(\text{CN})_2$ 

Formula Weight: 122.2

Boiling Point: 175 to 176° C. (at 14 mm.)

Specific Gravity: 0.949 at 18° C.

## Solubility:

insoluble in water    ∞ (in alcohol)  
∞ (in ether)

## PINACOLIN

## Synonyms:

tert-butyl methyl ketone  
3,3-dimethyl-2-butanone

Formula:  $\text{CH}_3\text{COC}(\text{CH}_3)_2$ 

Formula Weight: 100.2

Melting Point: -52.5° C.

Boiling Point: 106.2° C. (at 760 mm.)

## Specific Gravity:

0.811    0.8208(0/4)

## Solubility (grams per 100 ml.):

2.51 at 15° C. (in water)  
soluble in alcohol    soluble in ether  
very soluble in acetone

## PINACOLYL ACETATE

## Synonyms:

2,3-dimethyl-2,3-butanediol acetate

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_{13}$ 

Formula Weight: 144.2

Boiling Point: 143° C. (at 757 mm.)

## PINACOLYL ALCOHOL

## Synonyms:

3,3-dimethyl-2-butanol  
methyl tert-butylcarbinol

Formula:  $(\text{CH}_3)_3\text{CCHOHCH}_3$

Formula Weight: 102.2

Melting Point:  $5.5^\circ\text{C}$ .

Boiling Point:  $121$  to  $123^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.812 at  $25^\circ\text{C}$ .

Solubility:

very slightly soluble in water

soluble in alcohol  $\infty$  (in ether)

### d-PINANE

Synonyms: 2,6,6-trimethylnorpinane

Formula:  $\text{C}_{10}\text{H}_{18}$

Formula Weight: 138.2

Melting Point:  $-45^\circ\text{C}$ .

Boiling Point:  $169.4^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.839(20/4)

### $\alpha$ -dl-PINENE

Synonyms:

dl- $\alpha$ -pinene

dl-2,6,6-trimethylbicyclo[3,1,1]-hept-2-ene

Formula:  $\text{C}_{10}\text{H}_{16}$

Formula Weight: 136.2

Melting Point:  $-55$  to  $-50^\circ\text{C}$ .

Boiling Point:

$154$  to  $156^\circ\text{C}$ . (at 760 mm.)

$158$  to  $161^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.8582 to 0.878(20/4)

0.860 to 0.863(15.5/15.5)

Refractive Index: 1.4658

Solubility:

very slightly soluble in water

$\infty$  (in absolute alcohol, ether, and chloroform)

### dl-PINOL

Synonyms:

6,8-epoxy-1-p-menthene

dl-sobrerone

4,7,7-trimethyl-6-oxabicyclo-[3,2,1]-oct-3-ene

Formula:  $\text{C}_{10}\text{H}_{16}\text{O}$

Formula Weight: 152.2

Boiling Point:  $183$  to  $184^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.953(20/20)

0.9420(20/4)

Refractive Index: 1.4715

Solubility:

soluble in alcohol, ether, and benzene

### 2-PIPECOLINE

Synonyms:

2-methylpiperidine

$\alpha$ -pipecoline

Formula:  $\text{CH}_3\text{CH}(\text{CH}_2)_4\text{NH}$

Formula Weight: 99.2

Melting Point:  $9^\circ\text{C}$ .

Boiling Point:  $119^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.862 at  $0^\circ\text{C}$ .

0.844 at  $24^\circ\text{C}$ .

Refractive Index: 1.44627 at  $24.3^\circ\text{C}$ .

Solubility:

soluble in water

insoluble in dilute potassium hydroxide solution

### 3-PIPECOLINE

Synonyms:

3-methylpiperidine

$\gamma$ -pipecoline

Formula:  $\text{CH}_2\text{NH}(\text{CH}_2)_3\text{CHCH}_3$

Formula Weight: 99.2

Boiling Point:  $125$  to  $126^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.864(0/4)

0.845 at  $24^\circ\text{C}$ .

## 3-PIPECOLINE

### 3-PIPECOLINE (Cont.)

Refractive Index: 1.43779 at 21.6°C.

Solubility: very soluble in water

## 4-PIPECOLINE

Synonyms:

4-methylpiperidine

$\gamma$ -pipecoline

Formula:  $\text{CH}_2\text{CH}_2\text{NH}(\text{CH}_2)_2\text{CHCH}_3$

Formula Weight: 99.2

Boiling Point: 127 to 129°C. (at 760 mm.)

Specific Gravity: 0.867 at 0°C.

Solubility: soluble in water

## PIPERIDINE

Synonyms:

hexahydropyridine

hexazane

pentamethylenimine

Formula:  $\text{CH}_2(\text{CH}_2)_4\text{NH}$

Characteristics:

characteristic amine odor

Formula Weight: 85.2

Melting Point:

-17 to -9°C.      -13°C.

Boiling Point:

104 to 107°C. (at 760 mm.)

106.3°C. (at 760 mm.)

Specific Gravity:

0.8620(20/4)

0.860 to 0.863(25/25)

0.868(15.5/15.5)

Refractive Index: 1.4535

Uses:

organic synthesis of germicides,  
pharmaceuticals, rubber accelerators,  
and wetting agents

Solubility:

$\infty$  (in water)

$\infty$  (in ether)

$\infty$  (in alcohol)

## PIPERIDINEETHANOL

Synonyms:

ethoxypiperidine

$\beta$ -hydroxyethylpiperidine

$\gamma$ -pipecolylcarbinol

piperethylalkine

Formula:  $\text{C}_5\text{H}_{10}\text{NCH}_2\text{CH}_2\text{OH}$

Formula Weight: 129.2

Boiling Point:

199°C. (at 760 mm.)

227 to 228°C. (at 760 mm.)

Specific Gravity: 1.006(15/4)

Solubility:

very soluble in water and alcohol

## PIPEROLDINE

Synonyms:

$\delta$ -coniceine

octahydropyrrocoline

Formula:  $\text{C}_8\text{H}_{15}\text{N}$

Formula Weight: 125.2

Boiling Point:

dl: 161°C. (at 760 mm.)

l: 158°C. (at 760 mm.)

Specific Gravity: 0.904(15/4)

## PIPERYLENE

Synonyms:

$\alpha$ -methylbivinyll

1,3-pentadiene

Formula:  $\text{CH}_2\text{:CHCH:CHCH}_3$

Formula Weight: 68.1

Boiling Point: 42 to 44°C. (at 760 mm.)

Specific Gravity:

0.679(25/4)

0.696

Refractive Index: 1.4402 at 16.5°C.

# POLYETHYLENE GLYCOL DI-2-ETHYLHEXOATE

## Additional Data:

	trans	cis
specific gravity of gas (ideal; air = 1.0)	2.3515	2.3515
of liquid (in vacuo) at 20/40° C.	0.8764	0.8905
at 60/60° F.	0.8815	0.8956
API gravity at 60° F., ° API	76.1	71.9
liquid density (in vacuo) at 60° F., lbs./gal.	5.821	5.799
refractive index at 20° C.	1.4299	1.4359
coefficient of expansion at 60 to 77° F.	0.00081	0.00080
total heating values (at 77° F.)		
Btu./lb.	20000	20000
Btu./cu. ft. - gas	112100	114400

## PIVALDEHYDE

Synonyms:  
 2,2-dimethylpropanal  
 pivalic aldehyde  
 trimethylacetaldehyde  
 Formula:  $(CH_3)_3CCHO$   
 Formula Weight: 86.1  
 Boiling Point: 30° C.  
 Melting Point: 74 to 75° C. (at 760 mm.)  
 Specific Gravity: 0.793 at 17° C.  
 Solubility:  
 soluble in alcohol    soluble in ether

Freezing Point: -45° C.  
 Boiling Point: 353 to 397° C. (at 760 mm.)  
 Specific Gravity:  
 0.92 to 0.93 at 20° C.  
 0.902(60/15)  
 7.72 lbs. per gal.

Refractive Index: 1.545  
 Viscosity (centipoises):  
 1064 at 20° C.    658.3 at 25° C.  
 Flash Point: 360° F. (open)

Uses:  
 coupling agent for mineral and  
 vegetable oils  
 heat transfer medium  
 plasticizer for dark colored resins  
 and asphalts

Solubility:  
 insoluble in water  
 soluble in methanol, ether, acetone,  
 benzene, gasoline, and ethyl acetate

Additional Data:  
 coefficient of expansion,  
 0.00089 per ° C.

## PIVALONITRILE

Synonyms:  
 tert-butylcyanide  
 2,2-dimethylpropanenitrile  
 α, α'-dimethylpropionitrile  
 trimethylacetoneitrile  
 Formula:  $(CH_3)_3CCN$   
 Formula Weight: 83.1  
 Boiling Point: 15 to 16° C.  
 Melting Point: 105 to 106° C. (at 760 mm.)

## POLYETHYLENE GLYCOL DI-2-ETHYLHEXOATE

Synonyms: Pentalene 92  
 Characteristics: dark amber

Synonyms: "Flexol" plasticizer 4GO  
 Characteristics:  
 mild odor    light colored

## POLYETHYLENE GLYCOL DI-2-ETHYLHEXOATE (Cont.)

Formula Weight: 446.0

Freezing Point:  $-80^{\circ}\text{C}$ .Boiling Point:  $215$  to  $290^{\circ}\text{C}$ . (at 5 mm.)

Specific Gravity:

0.9892(20/20)

8.232 lbs. per gal. at  $20^{\circ}\text{C}$ .

Refractive Index: 1.447

Viscosity (centipoises): 25.1 at  $20^{\circ}\text{C}$ .Flash Point:  $395^{\circ}\text{F}$ . (open)

Uses:

calendered, extruded and plastic compositions

surface coatings      synthetic rubber plasticizer

Solubility (per cent by weight at  $20^{\circ}\text{C}$ .):

0.01 (in water)

1.4 (water in polyethylene glycol di-2-ethylhexoate)

Additional Data:

change in specific gravity,

0.000799 per  $^{\circ}\text{C}$ .

coefficient of expansion,

0.00081 at  $20^{\circ}\text{C}$ ., 0.00083 at  $55^{\circ}\text{C}$ .

## Compatability of Polyethylene Glycol Di-2-Ethylhexoate with Various Resins

Resin	Ratio of Resin to 2-Polyethylene Glycol Di-2-Ethylhexoate		
	1:1	4:1	9:1
Vinyl Chloride-Acetate Resins	C	C	C
Vinyl Butyral Resin	I	I	I
Vinyl Chloride Resin	C	C	C
Vinyl Acetate Resin	I	C	C
Polystyrene	C*	C	C**
Cellulose Nitrate			
1/4 sec. R.S.	C	C	C
Ethyl Cellulose	C	C	C
Cellulose Acetate	I	I	I
Methyl Methacrylate	I	C**	C**

C - compatible

I - incompatible

\* - soft sticky film

\*\* - very little plasticizing action

## POLYPROPYLENE GLYCOL 150

Characteristics: nearly colorless

Formula Weight: approximately 150

Boiling Point:  $<300^{\circ}\text{C}$ . not more than 5%

Specific Gravity: 1.0200 to 1.0300(20/20)

Uses:

solvent for cellulose nitrate, shellac, kauri gum, rosin, "Vinylite", butyral resin XYSG, castor oil and its derivatives, casein, and gelatin compositions, glues, zein, cork, and special printing inks

partial solvent for low- and high viscosity cellulose acetate

heat transfer medium

humectant and plasticizer

Solubility:

soluble in water

immiscible with olive and soybean oils and gasoline

miscible with toluene and many other organic solvents

Additional Data:

somewhat less hygroscopic than either propylene glycol or glycerol

## PREHNITINE

Synonyms:

prehnitol

1,2,3,4-tetramethylbenzene

Formula:  $(\text{CH}_3)_4\text{C}_6\text{H}_2$ 

Formula Weight: 134.2

Melting Point:

 $-7.7^{\circ}\text{C}$ . $-4^{\circ}\text{C}$ .Boiling Point:  $204^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.901(20/4)

Refractive Index: 1.52031 at  $16^{\circ}\text{C}$ .

Uses: organic syntheses

Solubility:

insoluble in water       $\infty$  (in alcohol)  
 $\infty$  (in ether)

dl-1,2-PROPANEDIAMINE

## Synonyms:

1,2-diaminopropane  
dl-propylenediamine

Formula:  $\text{CH}_3\text{CH}(\text{NH}_2)\text{CH}_2\text{NH}_2$

Characteristics: ammoniacal odor

Formula Weight: 74.1

## Boiling Point:

119 to 120° C. (at 760 mm.)  
119.7° C. (at 760 mm.)

Vapor Pressure (mm. Hg): 9.4 at 20° C.

## Specific Gravity:

0.878 at 15° C.      0.8732(20/20)  
7.3 lbs. per gal. at 20° C.

Flash Point: 120° F. (open)

## Uses:

syntheses of dyes and pharmaceuticals  
 solvent for castor oil, cellulose  
 nitrate, copal gum, some dyes, rosin,  
 pine oil, and shellac

## Solubility:

∞ (in water, benzene, and naphtha)  
 miscible with common organic solvents

## 1,3-PROPANEDIAMINE

## Synonyms:

1,3-diaminopropane  
 trimethylenediamine

Formula:  $\text{NH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

Characteristics: amine odor

Formula Weight: 74.1

## Boiling Point:

135.5° C. (at 760 mm.)  
133 to 140° C. (at 760 mm.)  
135 to 136° C. (at 738 mm.)

## Specific Gravity:

0.884(25/4)      0.886(20/20)

Refractive Index: 1.459

Flash Point: 75° F. (open)

## Solubility:

soluble in water, acetone, benzene,  
 gasoline, and ethyl acetate  
 ∞ (in alcohol)      ∞ (in ether)

## 1,2-PROPANEDIOL

## Synonyms:

1,2-dihydroxypropane  
 methylethylene glycol  
 methyl glycol  
 propylene glycol  
*d*-propylene glycol

Formula:  $\text{CH}_2\text{OHCHOHCH}_3$

## Characteristics:

oily      hygroscopic  
 nearly colorless

Formula Weight: 76.1

## Boiling Point:

188.2° C. (at 760 mm.)  
185 to 190° C. (at 760 mm.)  
180 to 200° C. (at 760 mm.)  
188 to 189° C. (at 760 mm.)

## Specific Gravity:

1.040 at 19.4° C.  
1.0381(20/20)  
1.035 to 1.037(25/25)  
1.036(77/77)° F.  
8.62 lbs. per gal. at 20° C.

## Refractive Index:

1.4300 to 1.4310 at 25° C.  
1.4293 at 27° C.

## Surface Tension (dynes per cm.):

36 at 77° F.

## Viscosity (centipoises):

230 at 32° F.      3 at 150° F.  
 43 at 77° F.

## Flash Point:

210° F. (closed)      225° F. (open)

Specific Heat (gram-calories per g.  
 per ° C.) (liquid): 0.590 at 20° C.

Heat of Vaporization (gram-calories  
 per g.): 168.6 at the boiling point

Heat of Combustion (kilogram-calories  
 per mole): 431.0

### 1,2-PROPANEDIOL (Cont.)

Answer:

moistening agent for tobacco and lead pencils  
antifreeze agent  
chemical intermediate in manufacture of synthetic drying oil and treatment of vegetable oils  
inhibitor of mold growth and fermentation  
component of brake fluid compositions  
plasticizer in adhesives  
plasticizer and hygroscopic agent for cellulose products  
humectant for magnesium foundry sands  
solvent and spreading agent in dyes  
thickener solvent, and spreading agent in inks  
lubricant in refrigerating machines  
processing of films, leather, paints, paper, and resins  
solvent for dyes, fats, flavoring extracts, oils, perfumes and waxes

**Solubility:**

soluble in water, alcohol, and ether)  
miscible with many organic solvents

### Additional Data:

vapor density, 2.52  
coefficient of expansion,  
0.000695 to 20°C., 0.000743 to 55°C.  
pour point, -75°F.  
fire point (A.S.T.M., open cup), 216°F.

## 1,2-PROPANEDIOL DIACETATE

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}(\text{CH}_3\text{COO})\text{CH}_3$

Formula Weight: 160.2

Boiling Point: 186° C. (at 758 mm.)

Solubility (grams per 100 ml.):  
10 (in water)

## 1,2-PROPANEDIOL MONACETATE

**Formula:**  $\text{CH}_3\text{COOCH}_2\text{CHOHCH}_3$

Formula Weight: 118.1

**Boiling Point:** 182 to 183° C. (at 760 mm.)

**Specific Gravity:** 1.055 at 20° C.

**Solubility:** soluble in water

## 1,3-PROPANEDIOL

**Synonyms:** trimethylene glycol

**Formula:**  $\text{CH}_2\text{OHCH}_2\text{CH}_2\text{OH}$

Characteristics:  
viscous                      oily

**Formula Weight: 76.1**

Boiling Point:  
214° C. (at 760 mm.)  
with decomposition

Specific Gravity: 1.060(20/4) 1.0526(18/4)

Solubility:  
 $\infty$  (in water)                       $\infty$  (in alcohol)  
 very soluble in ether

## 1,3-PROPANEDITHIOL

**Synonyms:** trimethylene dimercaptan

**Formula:**  $\text{HSCH}_2\text{CH}_2\text{CH}_2\text{SH}$

**Characteristics:** oily

Formula Weight: 108.2

Boiling Point: 169 to 170° C. (at 760 mm)

**Solubility:**  
very slightly soluble in water  
∞ (in alcohol, ether, chloroform, and benzene)

## 1-PROPANETHIOL

Synonyms: n-propyl mercaptan

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{SH}$

**Formula Weight: 76.2**

**Melting Point:** -112 to -111.5° C.

Boiling Point:  
67.4° C. (at 760 mm.)  
67 to 68° C. (at 760 mm.)

Specific Gravity:  
0.837 at 20°C.      0.831 at 25°C.  
0.8537(25/4)

## Refractive Index:

1.438 at 20°C. 1.435 at 25°C.

## Solubility:

very slightly soluble in water  
soluble in alcohol soluble in ether

## 2-PROPANETHIOL

Synonyms: isopropyl mercaptan

Formula:  $(CH_3)_2CHSH$ 

Formula Weight: 76.2

Melting Point: -130.7°C.

Boiling Point: 58 to 60°C. (at 760 mm.)

## Specific Gravity:

0.809 at 20°C. 0.8055(25/4)

0.804 at 25°C.

Refractive Index: 1.422 at 25°C.

## Solubility:

slightly soluble in water  
∞ (in alcohol) ∞ (in ether)

## 2-PROPENE-1-THIOL

Synonyms: allyl mercaptan

Formula:  $CH_2=CHCH_2SH$ 

Formula Weight: 74.1

Boiling Point: 90°C. (at 760 mm.)

## Solubility:

insoluble in water ∞ (in alcohol)  
∞ (in ether)

## PROPENYLBENZENE

## Synonyms:

isoallylbenzene 1-propenylbenzene  
1-phenylpropeneFormula:  $CH_3CH=CHC_6H_5$ 

Formula Weight: 118.2

Melting Point: -30.1°C.

Boiling Point: 175 to 178°C. (at 760 mm.)

## Specific Gravity:

0.914(20/4) 0.924(16/4)

## Solubility:

insoluble in water soluble in alcohol  
very soluble in ether

## 4-PROPENYLVÉRATROL

## Synonyms:

isoeugenol methyl ether  
methyllisoeugenolFormula:  $CH_3CH=CHC_6H_3(OCH_3)_2$ 

Formula Weight: 178.2

Boiling Point: 282 to 284°C. (at 760 mm.)

Specific Gravity: 1.0551 at 22°C.

Refractive Index: 1.5720 at 11.5°C.

## Solubility:

insoluble in water soluble in ether  
soluble in alcohol

## PROPIOLALDEHYDE

## Synonyms:

propargylaldehyde propynal

Formula:  $CH_3C\equiv CCHO$ 

Characteristics: oily

Formula Weight: 54.1

Boiling Point: 59 to 61°C. (at 760 mm.)

Solubility: very soluble in water

## PROPIOLIC ACID

## Synonyms:

acetylenecarboxylic acid  
propargylic acid propynoic acidFormula:  $CH_3C\equiv CCOOH$ 

Formula Weight: 70.1

Melting Point: 9°C.

## Boiling Point:

144°C. (at 760 mm.)  
with decomposition  
102°C. (at 200 mm.)

Specific Gravity: 1.139(15/15)

## Solubility:

soluble in water, alcohol, and ether

## PROPIONALDEHYDE

## Synonyms:

methylacetaldehyde  
propanal  
propionic aldehyde  
propyl aldehyde  
propylic aldehyde

Formula:  $\text{CH}_3\text{CH}_2\text{CHO}$

Characteristics: suffocating odor

Formula Weight: 58.1

Melting Point:  $-81^\circ\text{C}$ .

Boiling Point:

$48.8^\circ\text{C}$ . (at 760 mm.)

$49.5^\circ\text{C}$ . (at 740 mm.)

Specific Gravity: 0.807(20/4)

Refractive Index: 1.36356

## Uses:

disinfectant  
preservative  
rubber accelerators  
synthesis of propionic acid and other compounds  
synthetic resins

Solubility (grams per 100 ml.):

20 at  $20^\circ\text{C}$ . (in water)

$\infty$  (in alcohol)  $\infty$  (in ether)

## PROPIONALDEHYDE OXIME

## Synonyms:

propanal oxime propionaldoxime

Formula:  $\text{C}_2\text{H}_5\text{CH:NOH}$

Formula Weight: 73.1

Melting Point:  $21^\circ\text{C}$ .

Boiling Point:

$130$  to  $132^\circ\text{C}$ . (at 760 mm.)

$131$  to  $135^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.926(20/4)

## PROPIONIC ACID

## Synonyms:

ethylcarbonic acid methylacetic acid  
metactonic acid propanoic acid

Formula:  $\text{CH}_3\text{CH}_2\text{COOH}$

## Characteristics:

sour taste

pungent, fragrant odor which on dilution becomes similar to that of butyric acid

Formula Weight: 74.1

Melting Point:

$-22^\circ\text{C}$ .

$-19.3^\circ\text{C}$ .

Boiling Point:

$140.7$  to  $141.1^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.9870

0.992(20/4)

Refractive Index: 1.38736 at  $19.9^\circ\text{C}$ .

## Uses:

fruit flavors perfume esters  
manufacture of anethol and propionates  
solvent mixtures for cellulose derivatives

## Solubility:

$\infty$  (in water, alcohol, ether, and chloroform)

## Additional Data:

acid number (neutralization value),  
 $757.1$

critical temperature,  $239.5^\circ\text{C}$ .

critical pressure,  $53.0$  atm.

## PROPIONIC ANHYDRIDE

Synonyms: propanoic anhydride

Formula:  $(\text{CH}_3\text{CH}_2\text{CO})_2\text{O}$

Characteristics: pungent odor

Formula Weight: 130.1

Melting Point:  $-45^\circ\text{C}$ .

Boiling Point:

$166$  to  $169.3^\circ\text{C}$ . (at 760 mm.)

$169.0^\circ\text{C}$ . (at 760 mm.)

Vapor Pressure (mm. Hg): 1.0 at  $20^\circ\text{C}$ .

Specific Gravity:

1.0336(0/4)

1.0119(20/20)

1.010(20/4)

8.4 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4038

Flash Point: 165° F. (open)

Uses:

acylating agent      organic synthesis

Solubility:

decomposed by water and alcohol  
∞ (in ether)

PROPIONIN

Synonyms:

glycerol monopropionin  
α-monopropionin

Formula:  $C_2H_5COOCH_2CHOHCH_2OH$

Boiling Point: 141 to 144° C. (at 6 mm.)

Specific Gravity: 1.154(20/4)

PROPIONITRILE

Synonyms:

ethyl cyanide      propanenitrile

Formula:  $CH_3CH_2CN$

Characteristics:

toxic      ethereal odor

Formula Weight: 55.1

Melting Point:

-104 to -91.9° C.      -103.5° C.

Boiling Point: 96 to 97.1° C. (at 760 mm.)

Specific Gravity:

0.783(21/4)      0.7799

Refractive Index: 1.36888 at 14.6° C.

Uses: organic syntheses

Solubility (grams per 100 ml.):

11.9 at 40° C.; 28 at 100° C. (in water)

∞ (in alcohol)

very soluble in ether

PROPIONYL BROMIDE

Synonyms: propanoyl bromide

Formula:  $CH_3CH_2COBr$

Formula Weight: 137.0

Boiling Point: 103 to 104° C. (at 760 mm.)

Specific Gravity: 1.521(16/4)

Solubility:

decomposed by water and alcohol  
soluble in ether

PROPIONYL CHLORIDE

Synonyms: propanoyl chloride

Formula:  $CH_3CH_2COCl$

Characteristics:

pungent odor  
irritates eyes and throat

Formula Weight: 92.5

Melting Point: -94° C.

Boiling Point:

80° C. (at 760 mm.)

73 to 82° C. (at 760 mm.)

Specific Gravity:

1.065(20/4)

1.061(15.5/15.5)

Refractive Index: 1.40507

Flash Point: 53.6° F. (closed)

Uses:

introduction of propionyl groups  
synthesis of propionamide,  
propionates, etc.

Solubility:

decomposed by water and alcohol  
soluble in ether

∞ (in acetone, benzene, carbon tetra-  
chloride, linseed oil, and petroleum  
ether)

miscible with many organic solvents

PROPIONYL FLUORIDE

Synonyms: propanoyl fluoride

Formula:  $CH_3CH_2COF$

Formula Weight: 76.1

Boiling Point: 44° C. (at 760 mm.)

Specific Gravity: 0.972 at 15° C.

Solubility:

decomposed by water and alcohol

# PROPIONYL IODIDE

Synonyms: propanoyl iodide

Formula:  $\text{CH}_3\text{CH}_2\text{COI}$

Formula Weight: 184.0

Boiling Point: 127 to 128° C. (at 760 mm.)

Solubility:

decomposed by water and alcohol

# PROIOPHENONE

Synonyms:

ethyl phenyl ketone

1-phenyl-1-propanone

Formula:  $\text{C}_2\text{H}_5\text{COC}_6\text{H}_5$

Formula Weight: 134.2

Melting Point: 21° C.

Boiling Point: 218.0° C. (at 760 mm.)

Specific Gravity:

1.012(20/20)

1.012(20/4)

Refractive Index: 1.52900 at 15.9° C.

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

# PROPYL ACETATE

Synonyms:

acetic acid propyl ester

n-propyl acetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3$

Characteristics:

pleasant, fresh fruit odor

bitter-sweet taste pear flavor

Formula Weight: 102.1

Melting Point: -92.5° C.

Boiling Point:

101.6° C. (at 760 mm.)

96.0 to 102.0° C. (at 760 mm.)

Specific Gravity:

0.899

7.36 lbs. per gal.

0.887(20/4)

Refractive Index: 1.38438

Inflammability Range (volume per cent in air):

2.0 (lower limit)

8.0 (upper limit)

Flash Point: 58° F. (closed)

Uses:

flavoring agents

perfumery

lacquers

plastics

organic syntheses

solvent for nitrocellulose, many

cellulose derivatives, and many

resins

synthetic apple, Emperor pear,

cucumber, currant, melon, pear and

raspberry flavors

Solubility (grams per 100 ml.):

1.6 at 16° C., 1.89 at 20° C. (in water)

∞ (in alcohol, ether, oils, and

hydrocarbons)

miscible with alcohols, esters, and

ketones

Additional Data:

critical temperature, 276.2° C.

critical pressure, 33.2 atm.

vapor density, 3.52

# PROPYL ADIPATE

Synonyms:

adipic acid (di-)propyl ester

dipropyl adipate

n-propyl adipate

Formula:

$\text{CH}_3(\text{CH}_2)_2\text{OOC}(\text{CH}_2)_4\text{COO}(\text{CH}_2)_2\text{CH}_3$

Formula Weight: 230.3

Melting Point: -20.3° C.

Boiling Point: 134 to 135° C. (at 10 mm.)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

# PROPYL ALCOHOL

Synonyms:

ethyl carbinol

n-propyl alcohol

1-propanol

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

**Characteristics:**

somewhat stupefying odor but  
resembling that of ethyl alcohol

Formula Weight: 60.1

Melting Point:  $-127^{\circ}\text{C}$ .

**Boiling Point:**

$97$  to  $98^{\circ}\text{C}$ . (at  $760$  mm.)

$97.2^{\circ}\text{C}$ . (at  $760$  mm.)

**Specific Gravity:**

$0.8044(20/4)$   $0.808$  at  $20^{\circ}\text{C}$ .

$0.7998(25/4)$

$6.7$  lbs. per gal. at  $20^{\circ}\text{C}$ .

Refractive Index:  $1.38543$

Vapor Pressure (psi.):  $0.9$  at  $37.8^{\circ}\text{C}$ .

Inflammability Range (volume per cent  
in air):  $2.5$  (lower limit)

**Flash Point:**

$59^{\circ}\text{F}$ . (closed)  $85^{\circ}\text{F}$ . (open)

**Uses:**

cosmetics, lacquers, organic  
syntheses, propyl aldehyde,  
n-propyl esters  
solvent for cellulose esters and ethers,  
dopes, natural and synthetic resins,  
vegetable oils, and waxes  
solvent mixtures

**Solubility:**

$\infty$  (in water, alcohol, and ether)  
soluble in nearly all organic solvents

**Additional Data:**

autoignition temperature,  $812^{\circ}\text{F}$ .

vapor density,  $2.07$

critical temperature,  $263.7^{\circ}\text{F}$ .

critical pressure,  $49.9$  atm.

**PROPYLAMINE****Synonyms:**

1-aminopropane  
mono-n-propylamine  
n-propylamine

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

Characteristics: amine odor

Formula Weight:  $59.1$

Melting Point:  $-83^{\circ}\text{C}$ .

**Boiling Point:**

$48.7^{\circ}\text{C}$ . (at  $760$  mm.)

$46$  to  $51^{\circ}\text{C}$ . (at  $760$  mm.)

$49$  to  $50^{\circ}\text{C}$ . (at  $761$  mm.)

**Specific Gravity:**

$0.718(20/20)$   $0.719$

**Refractive Index:**

$1.389$  at  $20^{\circ}\text{C}$ .  $1.39006$  at  $16.6^{\circ}\text{C}$ .

Viscosity (centipoises):  $0.35$  at  $25^{\circ}\text{C}$ .

Flash Point:  $<20^{\circ}\text{F}$ . (closed)

**Solubility:**

very soluble in water  
soluble in chloroform, acetone,  
benzene, gasoline, and ethyl acetate  
 $\infty$  (in alcohol)  $\infty$  (in ether)

**Additional Data:**

critical temperature,  $223.8^{\circ}\text{C}$ .

critical pressure,  $46.8$  atm.

**N-PROPYLANILINE**

Formula:  $\text{C}_6\text{H}_5\text{NHCH}_2\text{CH}_2\text{CH}_3$

**Characteristics:**

oily pale yellow

Formula Weight:  $135.2$

Boiling Point:  $222^{\circ}\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.949(18/4)$

**Solubility:**

insoluble in water  
very soluble in alcohol and ether

**PROPYLBENZENE****Synonyms:**

1-phenylpropane n-propylbenzene

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_3$

Formula Weight:  $120.2$

Melting Point:  $-101.6$  to  $-99.2^{\circ}\text{C}$ .

**Boiling Point:**

$159.45^{\circ}\text{C}$ . (at  $760$  mm.)

$153$  to  $157^{\circ}\text{C}$ . (at  $760$  mm.)

Specific Gravity:  $0.862(20/4)$

## PROPYLBENZENE (Cont.)

## Refractive Index:

1.49195 at 20° C.

1.49549 at 12.25° C.

Flash Point: 86° F. (closed)

Specific Heat (Btu./lb. per ° F.):

0.445 at 50 to 175° F.

Heat of Vaporization (Btu./lb.):

136.8 at the boiling point

165.37 at 77° F.

Solubility (grams per 100 ml.):

0.006 at 15° C. (in water)

very soluble in alcohol and ether

## Additional Data:

specific gravity of gas

(ideal; air = 1.0), 4.1492

 specific gravity of liquid (in vacuo)

at 20/4° C., 0.86198

at 60/60° F., 0.86656

 liquid density (in vacuo) (lbs./gal.),

7.2247 at 60° F.

API gravity at 60° F., ° API, 31.8

aniline point, &lt; -22° F.

critical temperature, 690° F.

critical pressure, 745 psia.

coefficient of expansion,

0.00054 at 32 to 104° F.

total heating values (at 77° F.),

18,667 Btu./lb.

133,620 Btu./cu. ft. - gas

vapor density, 4.14

## PROPYL BENZOATE

## Synonyms:

 benzoic acid n-propyl ester

n-propyl benzoate

 Formula:  $C_6H_5COOCH_2CH_2CH_3$ 

## Characteristics:

faint fruity odor      date flavor

bitter taste

Formula Weight: 164.2

Melting Point: -51.6° C.

Boiling Point:

229 to 231.2° C. (at 760 mm.)

Specific Gravity:

1.021(25/25)

1.0274(15/4)

## Uses:

 synthetic bilberry, cranberry, date,  
gooseberry, huckleberry, and peach  
flavors

## Solubility:

very slightly soluble in water

∞ (in alcohol)

∞ (in ether)

 PROPYL o-BENZOYL BENZOATE

 Formula:  $C_6H_5COC_6H_4COOCH_2CH_2CH_3$ 

Formula Weight: 268.3

Boiling Point: 223 to 235° C. (at 15 mm.)

## Solubility:

insoluble in water

soluble in alcohol

soluble in ether

d-PROPYLBENZYL ALCOHOL

## Synonyms:

propylphenyl carbinol

propylphenyl methanol

 Formula:  $CH_3CH_2CH_2CHOHC_6H_5$ 

Characteristics: oily

Formula Weight: 150.2

Boiling Point: 168 to 170° C. (at 100 mm.)

Specific Gravity: 1.021(18/4)

## PROPYL BORATE

## Synonyms:

tripropoxyboron

tripropyl borate

 Formula:  $B(OCH_2CH_2CH_3)_3$ 

Formula Weight: 188.1

Boiling Point: 175° C. (at 760 mm.)

Specific Gravity: 0.867 at 16° C.

## Solubility:

decomposed by water

∞ (in alcohol)

∞ (in ether)

### PROPYL BUTYRATE

#### Synonyms:

butyric acid propyl ester  
n-propyl butyrate

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_3$

#### Characteristics:

agreeable sweet, fruity odor  
 sweet taste                      apricot flavor

Formula Weight: 130.2

Melting Point:  $-95.2^\circ\text{C}$ .

Boiling Point:  $124$  to  $143^\circ\text{C}$ . (at 760 mm.)

#### Specific Gravity:

0.897(15/4)                      0.8710(25/4)

Refractive Index: 1.4005

#### Uses:

synthetic apricot, peach, and pineapple  
 flavors  
 solvent mixtures for cellulose ethers

#### Solubility (grams per 100 ml.):

0.167 at  $17^\circ\text{C}$ . (in water)  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

### PROPYL CAPROATE

#### Synonyms:

caproic acid propyl ester  
n-propyl caproate

Formula:  $\text{C}_5\text{H}_{11}\text{COOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 158.2

Boiling Point:  $185.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.884(0/0)

### PROPYL CAPRYLATE

#### Synonyms:

caprylic acid propyl ester  
n-propyl caprylate

Formula:  $\text{C}_7\text{H}_{15}\text{COOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 186.3

Boiling Point:  $224.7^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.880(0/0)

### PROPYL CARBONATE

#### Synonyms:

carbonic acid propyl ester  
 di-n-propyl carbonate  
n-propyl carbonate

Formula:  $\text{CO}(\text{OCH}_2\text{CH}_2\text{CH}_3)_2$

Formula Weight: 146.2

Boiling Point:  $168.2^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.9411(20/4)

#### Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

### PROPYL CHLOROFORMATE

#### Synonyms:

chloroformic acid propyl ester  
n-propyl chloroformate  
n-propyl chlorocarbonate

Formula:  $\text{ClCOOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 122.6

#### Boiling Point:

$116^\circ\text{C}$ . (at 760 mm.)  
 $114$  to  $115^\circ\text{C}$ . (at 768 mm.)

Specific Gravity: 1.090(20/4)

#### Solubility:

decomposed by water  
 $\infty$  (in alcohol, ether, and benzene)

### PROPYLENE OXIDE

#### Synonyms:

1,2-epoxypropane                      propene oxide  
 methyloxirane

Formula:  $\text{OCH}_2\text{CHCH}_3$

#### Characteristics:

volatile                      ethereal odor

Formula Weight: 58.1

Melting Point:  $-112.1^\circ\text{C}$ .

#### Boiling Point:

$35^\circ\text{C}$ . (at 760 mm.)  
 $33.9^\circ\text{C}$ . (at 760 mm.)  
 $32$  to  $37^\circ\text{C}$ . (at 760 mm.)

## PROPYLENE OXIDE (Cont.)

## Specific Gravity:

0.859(0/4)      0.8304(20/20)

0.8313(20/20)

6.9 lbs. per gal. at 20° C.

## Refractive Index: 1.466

## Inflammability Range (volume per cent in air):

2.1 (lower limit)      21.5 (upper limit)

## Flash Point:

&lt;20° F. (closed)      -35° F. (open)

## Uses:

fumigant      organic syntheses  
 food preservative      plastics  
 lacquers and coating compositions  
 solvent for cellulose acetate, gums,  
 hydrocarbons, shellac, synthetic  
 resins and nitrocellulose

## Solubility (grams per 100 ml.):

12.8 at 20° C. (of water)

45 at 20° C. (in water)

 ∞ (in alcohol, ether, acetone, benzene,  
 and carbon tetrachloride)

miscible with most organic solvents

## Additional Data: vapor density, 2.00

## PROPYL ETHER

## Synonyms:

 di-n-propyl ether      1-propoxypropane

 Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{O}$ 

Formula Weight: 102.2

Melting Point: -122° C.

Boiling Point: 89.5 to 91° C. (at 760 mm.)

## Specific Gravity:

0.744(21.2/0)      0.7360(20/4)

Refractive Index: 1.3807

## Solubility (grams per 100 ml.):

0.25 at 25° C. (in water)

∞ (in alcohol)      ∞ (in ether)

## PROPYL FORMATE

## Synonyms:

formic acid n-propyl ester  
n-propyl formate

 Formula:  $\text{HCOOCH}_2\text{CH}_2\text{CH}_3$ 

## Characteristics:

pleasant fruity odor  
 bitter-sweet taste      plum flavor

Formula Weight: 88.1

Melting Point: -92.9° C.

Boiling Point: 81.3° C. (at 760 mm.)

## Specific Gravity:

0.908      0.9006(20/4)

Refractive Index: 1.3771

Flash Point: 27° F. (closed)

## Uses:

synthetic arrack, lemon, orange, plum,  
 raspberry, strawberry, and woodruff  
 flavors and essences

## Solubility (grams per 100 ml.):

2.79 at 20° C. (in water)

∞ (in alcohol)      ∞ (in ether)

## Additional Data:

vapor density, 3.03

critical temperature, 264.8° C.

critical pressure, 39.5 atm.

## PROPYL FUROATE

## Synonyms:

furoic acid n-propyl ester  
n-propyl furoate

 Formula:  $\text{C}_4\text{H}_3\text{OCOOCH}_2\text{CH}_2\text{CH}_3$ 

Characteristics: aromatic odor

Formula Weight: 154.2

Boiling Point: 211° C. (at 760 mm.)

Specific Gravity: 1.075(26/4)

Refractive Index: 1.4737 at 25.9° C.

## Solubility:

insoluble in water      ∞ (in ether)  
 soluble in alcohol

## Additional Data:

turns yellow on exposure to light

 PROPYL  $\beta$ -FURYLACRYLATE

## Synonyms:

2-furaneacrylic acid n-propyl ester  
n-propyl  $\beta$ -2-furylacrylate

Formula:  
 $C_4H_9OCH_2CH_2COOCH_2CH_2CH_3$   
Formula Weight: 180.2  
Boiling Point: 119° C. (at 7 mm.)  
Specific Gravity: 1.0744(20/4)  
Refractive Index: 1.5229  
Solubility:  
insoluble in water    soluble in alcohol

4-PROPYL-4-HEPTANOL

Synonyms:  
tert-decyl alcohol    tripropyl carbinol  
Formula:  $(CH_3CH_2CH_2)_3COH$   
Characteristics: oily  
Formula Weight: 158.3  
Boiling Point: 190 to 192° C. (at 760 mm.)  
Specific Gravity: 0.8338(21/0)  
Solubility:  
insoluble in water    soluble in alcohol

PROPYL ISOBUTYRATE

Synonyms:  
isobutyric acid n-propyl ester  
n-propyl isobutyrate  
Formula:  $(CH_3)_2CHCOOCH_2CH_2CH_3$   
Characteristics:  
fruity odor                      pineapple flavor  
sweet taste  
Formula Weight: 130.2  
Boiling Point:  
133.9 to 135.4° C. (at 760 mm.)  
Specific Gravity:  
0.874                      0.884(0/4)  
Uses:  
synthetic apple, apricot, banana,  
greengage, gooseberry, mirabelle-  
plum, quince, rum, and strawberry  
essences  
Solubility:  
very slightly soluble in water  
soluble in alcohol

PROPYL ISOCYANIDE

Synonyms:  
isocyanic acid n-propyl ester  
propyl carbylamine  
Formula:  $CH_3CH_2CH_2NC$   
Formula Weight: 69.1  
Boiling Point: 99.5° C. (at 760 mm.)  
Solubility:  
insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

PROPYL ISOTHIOCYANATE

Synonyms:  
isothiocyanic acid n-propyl ester  
n-propyl isothiocyanate  
n-propyl mustard oil  
Formula:  $CH_3CH_2CH_2NCS$   
Formula Weight: 101.2  
Boiling Point: 152 to 157° C. (at 743 mm.)  
Specific Gravity:  
0.9909(0/4)                      0.978(16/4)  
Solubility:  
very slightly soluble in water  
∞ (in alcohol)                      ∞ (in ether)

PROPYL ISOVALERATE

Synonyms:  
isovaleric acid n-propyl ester  
n-propyl isovalerate  
Formula:  $(CH_3)_2CHCH_2COOCH_2CH_2CH_3$   
Characteristics:  
fresh odor of apple  
bitter-sweet taste  
apple flavor  
Formula Weight: 144.2  
Boiling Point: 155.9° C. (at 760 mm.)  
Specific Gravity: 0.863(20/4)  
Refractive Index: 1.4036  
Uses:  
synthetic apple, apricot, gooseberry,  
lemon, orange, peach, and pineapple  
flavors

## PROPYL ISOVALERATE (Cont.)

## Solubility:

insoluble in water  $\infty$  (in ether)  
 $\infty$  (in alcohol)  $\infty$  (in chloroform)

## PROPYL LACTATE

## Synonyms:

lactic acid n-propyl ester  
n-propyl lactate

Formula:  $\text{CH}_3\text{CHOHCOOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 132.2

Boiling Point: 122 to 123° C. (at 150 mm.)

## Solubility:

soluble in water, alcohol, and ether

## PROPYL LEVULINATE

## Synonyms:

levulinic acid n-propyl ester  
n-propyl levulinate

Formula:  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 158.2

## Boiling Point:

221° C. (at 760 mm.)  
 215 to 216° C. (at 760 mm.)

Specific Gravity: 0.990(20/4)

Uses: plasticizer for cellulose ethers

## PROPYL MALATE

## Synonyms:

dipropyl hydroxybutanedioate  
 di-n-propyl malate  
 malic acid n-propyl ester  
n-propyl malate

## Formula:

$\text{C}_3\text{H}_7\text{OOCCHOHCH}_2\text{COOC}_3\text{H}_7$

Formula Weight: 218.3

Melting Point: 10.5° C.

Boiling Point: 151° C. (at 10 mm.)

Specific Gravity: 1.075

Refractive Index: 1.4380

## PROPYL MALEATE

## Synonyms:

di n-propyl maleate  
 maleic acid n-propyl ester  
n-propyl maleate

Formula:  $(:\text{CHCOOCH}_2\text{CH}_2\text{CH}_3)_2$

Formula Weight: 200.2

Boiling Point: 114 to 117° C. (at 6 mm.)

Specific Gravity: 1.030(18.4/4)

## PROPYL MALONATE

## Synonyms:

di-n-propyl malonate  
 dipropyl propanedioate  
 malonic acid n-propyl ester

Formula:  $\text{CH}_2(\text{COOCH}_2\text{CH}_2\text{CH}_3)_2$

Formula Weight: 188.2

Boiling Point: 228.3° C. (at 760 mm.)

Specific Gravity: 1.027(0/0)

## PROPYL METHACRYLATE

Synonyms: methacrylic acid propyl ester

Formula:  $\text{CH}_2:\text{C}(\text{CH}_3)\text{COOC}_3\text{H}_7$

Formula Weight: 128.2

Boiling Point: 141° C. (at 760 mm.)

Specific Gravity: 0.902(15.6/15.6)

Refractive Index: 1.420 at 15.6° C.

## Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

N-PROPYL  $\alpha$ -NAPHTHYLAMINE

Formula:  $\text{C}_{10}\text{H}_7\text{NHCH}_2\text{CH}_2\text{CH}_3$

## Characteristics:

oily pale yellow

Formula Weight: 185.3

Boiling Point: 316 to 318° C. (at 771 mm.)

Solubility: insoluble in water

### PROPYL NITRATE

Synonyms: n-propyl nitrate

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{ONO}_2$

Formula Weight: 105.1

Boiling Point: 110.5° C. (at 760 mm.)

Specific Gravity: 1.058(20/4)

Solubility:

very slightly soluble in water  
soluble in alcohol      soluble in ether

### PROPYL NITRITE

Synonyms: n-propyl nitrite

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{ONO}$

Formula Weight: 89.1

Boiling Point: 57° C. (at 760 mm.)

Specific Gravity: 0.935(20/4)

Refractive Index: 1.3613

Solubility:

soluble in alcohol      soluble in ether

### PROPYLNITROAMINE

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHNO}_2$

Formula Weight: 104.1

Melting Point: -22° C.

Boiling Point: 128 to 129° C. (at 40 mm.)

Specific Gravity: 1.104 at 15° C.

Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)       $\infty$  (in ether)

### PROPYL OXALATE

Synonyms:

di-n-propyl oxalate  
dipropyl oxalate  
oxalic acid di-n-propyl ester

Formula:  $(\text{COOCH}_2\text{CH}_2\text{CH}_3)_2$

Formula Weight: 174.2

Boiling Point:

213.5° C. (at 760 mm.)  
214 to 215° C. (at 760 mm.)

Specific Gravity:

1.02      1.038(0/0)

Solubility:

slightly soluble in water  
decomposed by hot water  
 $\infty$  (in alcohol)      soluble in ether

### m-PROPYLPHENOL

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}_6\text{H}_4\text{OH}$

Formula Weight: 136.2

Melting Point: 26° C.

Boiling Point: 228° C. (at 760 mm.)

Solubility:

slightly soluble in water  
soluble in alcohol      soluble in ether

### o-PROPYLPHENOL

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}_6\text{H}_4\text{OH}$

Formula Weight: 136.2

Boiling Point:

220° C. (at 760 mm.)  
226.6° C. (at 760 mm.)  
221 to 226° C. (at 760 mm.)

Specific Gravity:

1.015 at 0° C.      1.000(15/15)

Solubility:

very slightly soluble in water  
soluble in alcohol      soluble in ether

### p-PROPYLPHENOL

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}_6\text{H}_4\text{OH}$

Formula Weight: 136.2

Melting Point: 21 to 22° C.

Boiling Point:

230 to 232° C. (at 760 mm.)  
232.6° C. (at 758 mm.)

Specific Gravity: 1.009 at 0° C.

Solubility:

slightly soluble in water  
soluble in alcohol

PROPYLPHOSPHORIC ACID

Synonyms: n-propylphosphoric acid

Characteristics: reddish-amber

Specific Gravity: 1.24 at 25° C.

Uses:

catalyst in urea resin formation  
polymerizing agent for oils and resins  
textile and paper processing

Solubility: soluble in water

Additional Data:

alkyl content: approximately 97%

PROPYL PROPIONATE

Synonyms:

propionic acid n-propyl ester  
propyl propanoate  
n-propyl propionate

Formula:  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_3$

Characteristics:

ethereal odor                      pear flavor  
bitter taste

Formula Weight: 116.2

Melting Point: -75.9° C.

Boiling Point:

123.4° C. (at 760 mm.)  
122 to 125° C. (at 760 mm.)  
122 to 123° C. (at 760 mm.)  
118 to 122° C. (at 760 mm.)

Specific Gravity:

0.883(20/4)                      7.31 lbs. per gal.

Refractive Index: 1.3935

Flash Point: 174.2° F. (closed)

Uses:

solvent for nitrocellulose  
synthetic apple, cucumber, currant,  
Emperor pear, melon, pear, and  
quince essences  
coating agents  
lacquers, paints, and varnishes

Solubility (grams per 100 ml.):

0.5 (in water)  
 $\infty$  (in alcohol and ether)  
soluble in most organic solvents

2-PROPYLPYRIDINE

Synonyms: Conyrine

Formula:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}_5\text{H}_4\text{N}$

Formula Weight: 121.2

Melting Point: 2° F.

Boiling Point: 165 to 168° C. (at 760 mm.)

Specific Gravity: <1

Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

PROPYL SALICYLATE

Synonyms:

n-propyl salicylate  
salicylic acid n-propyl ester

Formula:  $\text{HOC}_6\text{H}_4\text{COOCH}_2\text{CH}_2\text{CH}_3$

Formula Weight: 180.2

Boiling Point: 238 to 240° C. (at 760 mm.)

Specific Gravity: 1.009 at 15° C.

Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

PROPYL SUCCINATE

Synonyms:

di-n-propyl succinate  
succinic acid di-n-propyl ester

Formula:  $(\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3)_2$

Formula Weight: 202.2

Boiling Point: 250.8° C. (at 760 mm.)

Specific Gravity: 1.006 at 15° C.

PROPYL SULFATE

Synonyms: di n-propyl sulfate

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{SO}_4$

Characteristics: oily

Formula Weight: 182.2





Specific Gravity: 1.005(20/4)

Refractive Index: 1.42047

Solubility:

slightly soluble in water

soluble in alcohol    soluble in ether

### PSEUDOCUMENE

Synonyms:

1,2,4-trimethylbenzene

asym-trimethylbenzene

Formula:  $(\text{CH}_3)_3\text{C}_6\text{H}_3$

Formula Weight: 120.2

Melting Point:

-61°C.

-44.1°C.

-57.4°C.

Boiling Point:

162 to 165°C. (at 760 mm.)

169.8°C. (at 760 mm.)

Specific Gravity: 0.876(20/4)

Refractive Index: 1.50672 at 15.5°C.

Solubility:

insoluble in water

soluble in alcohol, ether, and benzene

### PSEUDOIONONE

Synonyms:

citrylidene acetone    Ionone (pseudo)

Formula:  $\text{C}_{13}\text{H}_{20}\text{O}$

Characteristics: oily

Formula Weight: 192.3

Boiling Point: 143 to 145°C. (at 12 mm.)

Specific Gravity: 0.898 at 20°C.

### PULEGONE

Synonyms: 4(8)-p-menthen-3-one

Formula:  $\text{C}_{10}\text{H}_{16}\text{O}$

Characteristics:

menthol-like odor    peppermint aroma

Formula Weight: 152.2

Boiling Point: 221 to 224°C. (at 760 mm.)

Specific Gravity: 0.9323(20/20)

Refractive Index: 1.48765 at 18.3°C.

Uses: synthetic peppermint compounds

Solubility:

insoluble in water     $\infty$  (in alcohol)

$\infty$  (in ether)

### 2-PYRAZOLINE

Synonyms:

4,5-dihydropyrazole     $\Delta^2$ -pyrazoline

pyrazoline

Formula:  $\text{NHN:CHCH}_2\text{CH}_2$

Formula Weight: 70.1

Boiling Point: 144°C. (at 760 mm.)

Solubility:

$\infty$  (in water)

$\infty$  (in alcohol)

slightly soluble in ether

### PYRIDAZINE

Synonyms:

1,2-diazine

orthodiazine

Formula:  $\text{N:NHCH:CHCH:CH}$

Formula Weight: 80.1

Melting Point: -8°C.

Boiling Point: 208°C. (at 760 mm.)

Specific Gravity: 1.107(20/4)

Refractive Index: 1.52311 at 23.5°C.

Solubility:

$\infty$  (in water)

soluble in hydrochloric acid, benzene,  
and sulfuric acid

very soluble in alcohol and ether

insoluble in ligroin

### PYRIDINE

Synonyms: azine

Formula:  $\text{N:CHCH:CHCH:CH}$

Characteristics:

colorless to slightly yellowish

burning taste

sharp penetrating odor

## PYRIDINE (Cont.)

Formula Weight: 79.1

Melting Point:  $-42^{\circ}\text{C}$ .

Boiling Point:

115 to  $116^{\circ}\text{C}$ . (at 760 mm.)115.3 $^{\circ}\text{C}$ . (at 760 mm.)

various commercial pyridines are available which boil in the ranges of  $114$  to  $118^{\circ}\text{C}$ .,  $111$  to  $117^{\circ}\text{C}$ .,  $115$  to  $125^{\circ}\text{C}$ .,  $114$  to  $122^{\circ}\text{C}$ .,  $117$  to  $132^{\circ}\text{C}$ ., and  $125$  to  $145^{\circ}\text{C}$ . at atmospheric pressure

Specific Gravity:

0.982(20/4)

8.20 lbs. per gal.

0.9746

Refractive Index: 1.50919 at  $21^{\circ}\text{C}$ .

Inflammability Range (volume per cent in air):

1.8 (lower limit) 12.4 (upper limit)

Flash Point:  $68^{\circ}\text{F}$ . (closed)

Uses:

pickling inhibitor in acid cleaning of iron and steel  
 anticorrosive underground paints  
 insecticides  
 alcohol denaturant  
 dyes  
 dyeing assistants in textile processing  
 incandescent gas mantle manufacture  
 medicines, Sulfapyridine  
 rubber accelerators  
 solvent for anhydrous metallic salts in paint, rubber and various other industries

Solubility:

$\infty$  (in water, alcohol, and ether)  
 soluble in benzene, benzene, and fatty oils, as well as most common organic solvents including alcohols, esters, ethers, ketones, aliphatic and aromatic hydrocarbons

Additional Data:

autoignition temperature,  $1065^{\circ}\text{F}$ .  
 vapor density, 2.73

## PYRIMIDINE

Synonyms:

1,3-diazine

methadiazine

m-diazine

miazine

Formula:  $\text{N:CHN:CHCH:CH}$ 

Formula Weight: 80.1

Melting Point:  $20$  to  $22^{\circ}\text{C}$ .Boiling Point:  $123$  to  $124^{\circ}\text{C}$ . (at 760 mm.)

Solubility:

very soluble in water

soluble in alcohol soluble in ether

## PYRROLE

Synonyms: azole

Formula:  $\text{NHCH:CHCH:CH}$ 

Formula Weight: 67.1

Boiling Point:  $131^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.948(20/4)

0.9669(21/4)

Refractive Index: 1.5035

Solubility:

insoluble in water and dilute alkalies  
 very soluble in alcohol and ether  
 soluble in benzene and dilute acids

## PYRROLIDINE

Synonyms:

tetrahydropyrrole

tetramethylenimine

Formula:  $\text{NHCH}_2\text{CH}_2\text{CH}_2\text{CH}_2$ 

Formula Weight: 71.1

Boiling Point:  $88.5^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.871 at  $10^{\circ}\text{C}$ .0.8510 at  $22^{\circ}\text{C}$ .

Solubility:

 $\infty$  (in water)  $\infty$  (in ether) $\infty$  (in alcohol)  $\infty$  (in chloroform)

## 2-PYRROLIDONE

Synonyms:

2-oxopyrrolidine

 $\alpha$ -pyrrolidone

Formula:  $\text{NHCOCH}_2\text{CH}_2\text{CH}_2$

Formula Weight: 85.1

Melting Point:  $24.6^\circ\text{C}$ .

Boiling Point:

$245^\circ\text{C}$ . (at 760 mm.)

$250.8^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.116 at  $25^\circ\text{C}$ .

Solubility:

very soluble in water, alcohol, and ether

### PYRROLINE

Synonyms: dihydropyrrole

Formula:  $\text{CH}_2\text{CH}_2\text{NHCH:CH}$

Formula Weight: 69.1

Boiling Point:  $90$  to  $91^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.910(20/4)

Solubility:

very soluble in water

$\infty$  (in alcohol)  $\infty$  (in ether)

### PYRUVALDEHYDE

Synonyms:

methylgloxal                  pyruvic aldehyde  
the commercial product is an approxi-  
mately 30% aqueous solution consist-  
ing of a mixture of different stable  
hydrated polymers  
this mixture is nearly odorless

Formula:  $\text{CH}_3\text{COCHO}$

Characteristics:

deep yellow                  hygroscopic  
penetrating odor

Formula Weight: 72.0

Boiling Point:  $72.0^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.0455 at  $24^\circ\text{C}$ .

Refractive Index: 1.4002 at  $17.5^\circ\text{C}$ .

Uses:

organic synthesis of dyes, polymers,  
and pharmaceuticals as well as  
various industrial chemicals

Solubility:

$\infty$  (in water with the formation of heat)  
soluble in ether                  soluble in benzene

Additional Data:

volatilizes readily and forms green  
vapors

in the absence of an inhibiting agent it  
polymerizes in a few hours to a  
brittle resin

### PYRUVIC ACID

Synonyms:

acetylformic acid  
*d*-ketopropionic acid  
2-oxopropanoic acid  
pyroracemic acid

Formula:  $\text{CH}_3\text{COCOOH}$

Formula Weight: 88.1

Melting Point:  $13.6^\circ\text{C}$ .

Boiling Point:

$165.0^\circ\text{C}$ . (at 760 mm.)

with slight decomposition

Specific Gravity: 1.267(20/4)

Solubility:

$\infty$  (in water, alcohol, and ether)

### PYRUVONITRILE

Synonyms:

acetyl cyanide  
2-oxopropanenitrile

Formula:  $\text{CH}_3\text{COCN}$

Formula Weight: 69.1

Boiling Point:  $93^\circ\text{C}$ . (at 760 mm.)

Solubility:

decomposed by water  
soluble in ether

## Q

## QUINALDINE

## Synonyms:

chinaldine  
 $\alpha$ - or 2-methylquinoline

Formula:  $\text{CH}_3\text{C}_9\text{H}_6\text{N}$

## Characteristics:

yellow                      oily

Formula Weight: 143.2

## Melting Point:

$-6^\circ\text{C.}$                        $-1^\circ\text{C.}$

## Boiling Point:

246 to  $247^\circ\text{C.}$  (at 760 mm.)  
 244 to  $245^\circ\text{C.}$  (at 750 mm.)

## Specific Gravity:

1.059(20/4)                      8.82 lbs. per gal.  
 1.1013

## Uses:

dyes                      rubber  
 insecticides                      accelerators  
 organic syntheses                      quinoline yellow  
 pharmaceuticals

## Solubility:

very slightly soluble in water  
 soluble in alcohol, ether, chloroform,  
 dilute mineral acids and in most  
 common organic solvents including  
 alcohols, ethers, esters, ketones,  
 aliphatic and aromatic hydrocarbons

## Additional Data:

becomes reddish-brown in the light

## QUINOLINE

## Synonyms:

1-benzazine                      leucoline  
 benzo(b)pyridine                      leukol  
 chinoline

Formula:  $\text{C}_6\text{H}_4\text{N:CHCH:CH}$

## Characteristics:

highly refractive                      hygroscopic  
 peculiar characteristic odor

Formula Weight: 129.2

## Melting Point:

$-19.5^\circ\text{C.}$                        $-15^\circ\text{C.}$

Boiling Point:  $237.7^\circ\text{C.}$  (at 760 mm.)

## Specific Gravity:

1.095(20/4)                      9.15 lbs. per gal.  
 1.0899

Refractive Index: 1.62450 at  $24.9^\circ\text{C.}$

## Uses:

antiseptics                      dyes  
 antipyretics and other pharmaceuticals  
 insecticides                      quinosol  
 rubber accelerators

## Solubility (grams per 100 ml.):

6 (in water)  
 $\infty$  (in alcohol, ether, and carbon  
 disulfide)  
 soluble in dilute mineral acids and in  
 most common organic solvents like  
 alcohols, ethers, esters, ketones,  
 and aliphatic and aromatic hydro-  
 carbons

## R

## RESORCINOL ACETATE

## Synonyms:

acetylresorcinol (1,3)  
euresol  
eurisol  
resorcinol monacetate

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_4\text{OH}$

## Characteristics:

yellow oily

Formula Weight: 152.1

## Boiling Point:

283° C. (at 760 mm.)  
with decomposition

## Uses:

medicine  
stabilizer of cracked gasolines and  
motor fuels

## Solubility:

insoluble in water  
 $\infty$  (in alcohol, chloroform,  
and benzene)  
soluble in alkalis and in most  
organic solvents

## RESORCINOL DIACETATE

Formula:  $(\text{CH}_3\text{COO})_2\text{C}_6\text{H}_4$

Characteristics: highly refractive

Formula Weight: 194.2

## Boiling Point:

278° C. (at 760 mm.)  
with slight decomposition

## Uses:

plasticizer for cellulose nitrate

## RHODINOL

## Synonyms:

reuniol roseol  
this is a mixture of geraniol and  
citronellol

Formula:  $\text{C}_{10}\text{H}_{19}\text{OH}$

## Characteristics:

tea-rose odor oily  
bitter taste strawberry flavor

Formula Weight: 156.3

## Boiling Point:

225 to 226° C. (at 760 mm.)  
113 to 114° C. (at 15 mm.)

Specific Gravity: 0.860 to 0.885

## Uses:

synthetic currant, raspberry, and  
strawberry flavors  
perfumes

## Solubility:

## Solubility in Water-Alcohol Mixtures

% Alcohol	Ratio
45	1:160
60	2:9
96	1:1

## RICINOLEIC ACID

## Synonyms:

12-hydroxy-9-octadecenoic acid  
ricinolic acid

## Formula:

$\text{CH}_3(\text{CH}_2)_5\text{CHOHCH}_2\text{CH:CH}(\text{CH}_2)_7\text{COOH}$

Characteristics: yellow

Formula Weight: 298.5

## Melting Point:

4 to 5° C. 17° C.

## Boiling Point:

250° C. (at 15 mm.)  
226 to 228° C. (at 10 mm.)

Specific Gravity: 0.945 at 15° C.

## Uses:

soaps turkey red oils  
textile finishing

## Solubility:

insoluble in water  
very soluble in chloroform  
 $\infty$  (in alcohol)  $\infty$  (in ether)

## S

## SABINENE

## Synonyms:

1-isopropyl-4-methylenebicyclo-  
[3,1,0]hexane

Formula:  $C_{10}H_{16}$

Formula Weight: 136.2

Boiling Point: 164 to 165°C. (at 760 mm.)

## Specific Gravity:

0.842                      0.848(15/15)

Refractive Index: 1.46738 at 17.0°C.

## Solubility:

insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

## d-SACCHARIC ACID

## Synonyms:

2,3,4,5-tetrahydroxyhexanedioic acid

Formula:  $COOH(CHOH)_4COOH$

Characteristics: syrupy

Formula Weight: 210.1

## Boiling Point:

125 to 126°C. (at 760 mm.)  
with decomposition

## Solubility:

very soluble in water and alcohol  
slightly soluble in ether and chloroform

## SAFROLE

## Synonyms:

1-allyl-3,4-methylenedioxybenzene  
4-allyl-1,2-methylenedioxybenzene  
allylpyrocatecholmethylene ether  
3,4-methylenedioxyallylbenzene  
propyldioxybenzenemethylene ester  
shikimole

Formula:  $CH_2(O_2)C_6H_3CH_2CH:CH_2$

## Characteristics:

pleasant sassafras odor and flavor  
colorless to pale yellow  
oily

Formula Weight: 162.2

Melting Point: 10 to 11.2°C.

## Boiling Point:

232 to 234°C. (at 760 mm.)  
234.5°C. (at 760 mm.)

## Specific Gravity:

1.100(20/4)                      1.096 to 1.105

## Refractive Index:

1.5383 to 1.5385 at 20°C.  
1.5420 at 12°C.

## Uses:

heliotropin                      piperonal  
medicines                      soaps  
perfumery  
synthetic birch beer, gooseberry, root  
beer, and sarsaparilla flavors

## Solubility:

insoluble in water    ∞ (in chloroform)  
very soluble in alcohol and ether

## SALICYLALDEHYDE

## Synonyms:

o-hydroxybenzaldehyde  
o-oxybenzaldehyde  
salicylic aldehyde  
salicylous acid

Formula:  $HOC_6H_4CHO$

## Characteristics:

dark red                      sharp pungent odor  
oily

Formula Weight: 122.1

## Melting Point:

-7°C.                      1.6°C.  
freezing point: 1.1°C.

Boiling Point: 196.5°C. (at 760 mm.)

## Specific Gravity:

1.153(25/4)                      1.163(25/25)  
1.1699(20/4)                      9.6 lbs. per gal.  
1.1(20/4)

Refractive Index: 1.57358 at 19.7° C.

Uses:

analytical reagent    synthetic perfumes  
organic syntheses

Solubility:

slightly soluble in water  
∞ (in alcohol, ether, benzene, and  
carbon tetrachloride)

*α*-SANTALOL

Synonyms:

arheol  
the commercial product is a mixture  
of *α*- and *β*-santalol

Formula:  $C_{15}H_{24}O$

Characteristics:

oily  
marked odor of sandalwood  
bitter-sweet, astringent taste

Formula Weight: 220.3

Boiling Point: 300° C. (at 760 mm.)

Specific Gravity: 0.997 to 0.984

Refractive Index: 1.505 to 1.509

Uses:

the commercial product is used for  
waxy essences and medicinals

Solubility:

insoluble in water    soluble in alcohol

Additional Data:

optical rotation of 0 to 1° C.

*β*-SANTALOL

Synonyms:

arheol  
the commercial product is a mixture  
of *α*- and *β*-santalol

Formula:  $C_{15}H_{24}O$

Characteristics:

oily  
marked odor of sandalwood  
bitter-sweet, astringent taste

Formula Weight: 220.3

Boiling Point: 309 to 310° C. (at 760 mm.)

Specific Gravity: 0.985 to 0.986

Refractive Index: 1.505 to 1.509

Uses:

the commercial product is used for  
waxy essences and medicinals

Solubility:

insoluble in water    soluble in alcohol

Additional Data:

optical rotation of -51 to -56° C.

SANTYLYL SALICYLATE

Synonyms: santyl

Formula:  $HOC_6H_4COOC_{15}H_{23}$

Characteristics:

yellow    oily

Formula Weight: 340.4

Boiling Point: 126.6° C. (at 20 mm.)

Specific Gravity: 1.07

Solubility:

insoluble in water    soluble in alcohol  
soluble in ether

SEBACONTRILE

Formula:  $CN(CH_2)_8CN$

Formula Weight: 164.2

Boiling Point: 199 to 200° C. (at 15 mm.)

SPARTEINE

Synonyms: lupinidine

Formula:  $C_{15}H_{26}N_2$

Characteristics: oily

Formula Weight: 234.4

Boiling Point:

325° C. (at 754 mm.), in hydrogen

Specific Gravity: 1.023(20/4)

Solubility (grams per 100 ml.):

0.304 at 22° C. (in water)  
very soluble in alcohol and ether  
soluble in chloroform and benzene

## STODDARD SOLVENT

a petroleum distillate of low flammability

## Boiling Range:

176° C. not less than 50%

190° C. not less than 90%

210° C. end point

## STYRENE

## Synonyms:

cinnamene	styrol
cinnamenol	styrolene
cinnamol	vinylbenzene
phenylethylene	

Formula:  $C_6H_5CH:CH_2$

## Characteristics:

characteristic aromatic, agreeable odor resembling amber and rubber solutions	
highly refractive	very bitter taste
yellow	almond flavor
oily	

Formula Weight: 104.1

Melting Point: -31° C.

## Boiling Point:

145.2° C. (at 760 mm.)

145 to 146° C. (at 760 mm.)

81 to 82° C. (at 100 mm.)

## Specific Gravity:

0.903 to 0.9074(20/4)

0.9014(25/25)

7.5 lbs. per gal. at 25° C.

## Refractive Index:

1.5428 at 25° C.      1.54344 at 17° C.

## Viscosity (centipoises):

0.51 at 60° C.      0.77 at 25° C.

Inflammability Range (volume per cent in air):

1.1 (lower limit)      6.1 (upper limit)

Flash Point: 90° F. (closed)

Specific Heat (gram-calories per g. per ° C.) (liquid): 0.32

## Heat of Vaporization:

85 gram-calories per g.

153 Btu. per lb.

## Uses:

rubber	medicines
organic syntheses	plasticizer

## Solubility:

very slightly soluble in water  
soluble in benzene and carbon tetrachloride

$\infty$  (in alcohol)       $\infty$  (in ether)

## Additional Data:

polymerizes on heating to a glassy solid

autoignition temperature, 914° F.

vapor density, 3.60

fire point, 93.2° F.

dielectric constant, 1000 cycle: 2.35

power factor, 1000 cycle: 0.07%

specific resistance,  
 $3.0 \times 10^{12}$  ohms cm

dielectric strength, volts at 0.1 in. gap,  
>30,000

heat of polymerization, 192 cal./g.

## SUBERALDEHYDE

Synonyms: octandial

Formula:  $CHO(CH_2)_6CHO$

Characteristics: oily

Formula Weight: 142.2

## Boiling Point:

230 to 240° C. (at 760 mm.)

with slight decomposition

Solubility: very soluble in water

## SUCCINALDEHYDE

Synonyms:

butanedial
succinic dialdehyde

Formula:  $CHOCH_2CH_2CHO$

Formula Weight: 86.1

## Boiling Point:

169 to 170° C. (at 760 mm.)

with slight decomposition

Specific Gravity:  
1.069(18/4)                      1.064(20/4)  
Refractive Index: 1.4524  
Solubility:  
soluble in water, alcohol, and ether

SUCCINYL CHLORIDE

Synonyms: butanedioyl chloride  
Formula: (CH<sub>2</sub>COCl)<sub>2</sub>  
Formula Weight: 155.0  
Melting Point: 17° C.  
Boiling Point:  
192 to 193° C. (at 760 mm.)  
192.5° C. (at 760 mm.)  
Specific Gravity: 1.395(20/4)  
Refractive Index: 1.47348 at 15.2° C.

Solubility:  
decomposed by water and alcohol  
very soluble in ether  
soluble in benzene  
insoluble in petroleum ether  
Additional Data: fumes

d-SYLVESTRENE

Synonyms: d-1,8(9)-m-menthadiene  
Formula: C<sub>10</sub>H<sub>16</sub>  
Formula Weight: 136.2  
Boiling Point: 176 to 177° C. (at 760 mm.)  
Specific Gravity: 0.863(20/4)  
Refractive Index: 1.47717 at 17.2° C.  
Solubility:  
insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

T

d-TERPINENE

Synonyms: 1,3-p-menthadiene  
Formula: C<sub>10</sub>H<sub>16</sub>  
Formula Weight: 136.2  
Boiling Point:  
180° C. (at 760 mm.)  
174 to 175° C. (at 760 mm.)  
Specific Gravity: 0.846  
Refractive Index: 1.4846  
Solubility:  
insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

β-TERPINENE

Synonyms: 1(7),3-p-menthadiene  
Formula: C<sub>10</sub>H<sub>16</sub>

Formula Weight: 136.2  
Boiling Point: 173 to 174° C. (at 760 mm.)  
Specific Gravity: 0.838 at 22° C.  
Solubility:  
insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

dl-d-TERPINEOL

Synonyms:  
lilacin  
dl-1-p-menthen-8-ol  
Formula: C<sub>10</sub>H<sub>17</sub>OH  
Characteristics:  
lilac odor                      peach aroma  
sweet, burning taste  
Formula Weight: 154.3



## 1,1,1,2-TETRABROMOETHANE

Synonyms: uns-tetrabromoethaneFormula:  $\text{CH}_2\text{BrCBr}_3$ 

Formula Weight: 345.7

Melting Point:  $0^\circ\text{C}$ .Boiling Point:  $103.5^\circ\text{C}$ . (at 13.5 mm.)

Specific Gravity: 2.875(20/4)

Refractive Index: 1.62772

Solubility: soluble in alcohol

Solubility (grams per 100 ml.):

0.0651 at  $30^\circ\text{C}$ ., 0.28 at  $80^\circ\text{C}$ .  
(in water) $\infty$  (in alcohol, ether, chloroform,  
aniline, acetic acid, and carbon  
tetrachloride)

miscible with most organic solvents

Additional Data: fire point, none

1,1,1,2-TETRABROMO-2-  
FLUOROETHANE

Synonyms: fluorotetrabromoethane

Formula:  $\text{CBr}_3\text{CHBrF}$ 

Formula Weight: 363.7

Boiling Point:  $103.5^\circ\text{C}$ . (at 23 mm.)Specific Gravity: 1.939 at  $16^\circ\text{C}$ .

## 1,1,2,2-TETRABROMOETHANE

Synonyms:

acetylene tetrabromide

Muthmann's liquid

sym-tetrabromoethaneFormula:  $\text{CHBr}_2\text{CHBr}_2$ 

Characteristics:

colorless to yellow

mild sweet odor

highly refractive

Formula Weight: 345.7

Melting Point:  $-1.0$  to  $0.1^\circ\text{C}$ .

Boiling Point:

 $239$  to  $242^\circ\text{C}$ . (at 760 mm.) $151^\circ\text{C}$ . (at 54 mm.) $119^\circ\text{C}$ . (at 15 mm.)

Specific Gravity:

2.9638(20/4)

2.953(25/25)

2.98 to 3.00

24.57 lbs. per gal. at  $25^\circ\text{C}$ .

Refractive Index:

1.63795 at  $20^\circ\text{C}$ .1.6338 at  $25^\circ\text{C}$ .

Flash Point:

none (closed)

none (open)

Uses:

fluid for liquid gauges

ore flotation

solvent for fats, oils, and waxes

## TETRABUTYLUREA

Formula:  $(\text{C}_4\text{H}_9)_2\text{NCON}(\text{C}_4\text{H}_9)_2$ 

Formula Weight: 284.5

Freezing Point:  $-60^\circ\text{C}$ .

Boiling Point:

 $305$  to  $315^\circ\text{C}$ . (at 760 mm.) $134$  to  $136^\circ\text{C}$ . (at 2 mm.)

Solubility:

insoluble in water

soluble in methanol, ether, acetone,  
benzene, gasoline, and ethyl acetate

## 1,1,1,2-TETRACHLOROETHANE

Synonyms: uns-tetrachloroethaneFormula:  $\text{CH}_2\text{ClCCl}_3$ 

Formula Weight: 167.9

Melting Point:  $-68.7^\circ\text{C}$ .

Boiling Point:

 $129$  to  $130.5^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.588(20/4)

Refractive Index: 1.48162 at  $23.2^\circ\text{C}$ .

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

## 1,1,2,2-TETRACHLOROETHANE

## Synonyms:

acetosol  
acetylene tetrachloride  
boroform  
cellon  
sym-tetrachloroethane

Formula:  $\text{CHCl}_2\text{CHCl}_2$ 

## Characteristics:

mobile                      corrosive  
toxic  
odor like that of chloroform

Formula Weight: 167.9

## Melting Point:

-43.8° C.                      -43° C.  
-42.5° C.                      -36° C.

## Boiling Point:

145.9 to 146.5° C. (at 760 mm.)

## Specific Gravity:

1.600(20/4)                      1.593(25/25)  
13.25 lbs. per gal. at 25° C.

## Refractive Index:

1.4938 to 1.4942 at 20° C.  
1.4918 at 25° C.

## Viscosity (centipoises):

1.77 at 20° C.                      1.59 at 25° C.

## Flash Point:

none (closed)                      none (open)

Specific Heat (gram-calories per g.  
per ° C.) (liquid): 0.268 at 20° C.

Heat of Vaporization (gram-calories  
per g.):

55.1 at the boiling point  
99.2 Btu./lb.

## Uses:

acetate varnishes  
dye intermediates  
ethyl alcohol denaturant  
fat and oil extraction  
lacquers, varnishes  
organic syntheses  
paint and varnish removers  
photographic films  
metal cleaning and degreasing  
solvent for cellulose acetate varnishes,

camphor, gums, plastics, phosphorus,  
sulfur, and shellac

Solubility (grams per 100 g.):

0.13 at 25° C. (of water)

0.29 at 25° C. (in water)

miscible with most organic solvents

## Additional Data:

specific resistivity,

 $4.2 \times 10^7$  ohms/cm.

steam distillation (1 atm.), 93.7° C.

solvent: water ratio, by weight:

2.41:1

critical temperature, 388.0° C.

thermal conductivity (liquid, 20° C.),

0.0778

coefficient of expansion,

0.00103 at 0 to 30° C.

vapor density,

g./l. 4.88

lb./cu. ft. 0.304

(sp.gr.; air = 1.00), 5.79

diffusivity in air (25° C.; 1 atm.;

sq. cm./sec.), 0.065

evaporation rate (ether = 100), 3

dielectric constant at 20° C., 8.00

fire point, none

weight of pure vapor (mg./l.), 7500

## TETRACHLOROETHYLENE

## Synonyms:

carbon bichloride  
carbon dichloride  
ethylene tetrachloride  
perchloroethylene  
tetrachloroethene

Formula:  $\text{CCl}_2:\text{CCl}_2$ 

## Characteristics:

mild

sweetish, pungent odor

Formula Weight: 165.9

Melting Point: -22.35 to -19.0° C.

## Boiling Point:

120.8 to 121.2° C. (at 760 mm.)

## Specific Gravity:

1.624 to 1.6311(15/4)

1.623(20/4)

1.618(25/25)

13.46 lbs. per gal. at 25°C.

## Refractive Index:

1.5044 to 1.50547 at 20°C.

1.5029 at 25°C.

## Surface Tension (dynes per cm.):

32.32 at 20°C.

## Viscosity (centipoises):

0.88 at 20°C.

0.84 at 25°C.

## Flash Point:

none (closed)

none (open)

## Specific Heat (gram-calories per g.

per °C.) (liquid): 0.205 at 20°C.

## Heat of Vaporization (gram-calories per g.):

50.1 at the boiling point90.2 Btu./lb.

## Uses:

degreasing

dry-cleaning soaps

dry cleaning solvents

organic syntheses

solvent

solvent mixtures for cellulose esters  
and ethers

## Solubility (grams per 100 g.):

0.0105 at 25°C. (of water)

0.015 at 25°C. (in water)

∞ (in alcohol, ether, chloroform,  
benzene, and carbon tetrachloride)

miscible with most organic solvents

## Additional Data:

fire point, none

dielectric constant, 1000 cycle: 2.20dielectric strength, 0.1" gap, in volts:  
>30,000power factor, 1000 cycle: 0.02%

specific resistivity,

 $1.8 \times 10^{13}$  ohms/cm.

steam distillation, 1 atm., °C.: 87.7

solvent: water ratio, by weight: 5.32:1

critical temperature, 347.1°C.

thermal conductivity, liquid, 20°C.:  
0.0732

coefficient of expansion,

0.00102 at 0 to 25°C.

vapor density,

g./l. 5.22

lb./cu. ft. 0.326

sp.gr.; air = 1.0 5.83

diffusivity in air, (25°C.; 1 atm.;

sq. cm./sec.): 0.067

evaporation rate (ether = 100), 9.

1,1,1,2-TETRACHLORO-2-  
FLUOROETHANE

Synonyms: fluorotetrachloroethane

Formula:  $\text{CCl}_3\text{CHClF}$ 

Formula Weight: 185.9

Boiling Point: 116.5°C. (at 760 mm.)

Specific Gravity: 1.631 at 16.7°C.

## 1,1,3,3-TETRACHLOROPROPANONE

Synonyms:

sym-tetrachloroacetonesym-tetrachloropropanoneFormula:  $(\text{CH}_2\text{Cl})_2\text{CO}$ 

Formula Weight: 195.9

Boiling Point:

180 to 182°C. (at 760 mm.)

with slight decomposition

Solubility:

very soluble in water, alcohol, and  
benzene

## TETRADECANE

Synonyms: n-tetradedaneFormula:  $\text{CH}_3(\text{CH}_2)_{12}\text{CH}_3$ 

Formula Weight: 198.4

Melting Point: 5.5°C.

Boiling Point:

252.5°C. (at 760 mm.)

251 to 253°C. (at 760 mm.)

Specific Gravity:

0.765(20/4)

0.7690.7636(20/4)

## TETRADECANE (Cont.)

Refractive Index:

1.4459                      1.4290Inflammability Range (volume per cent  
in air): 0.5 (lower limit)Flash Point: 212° F. (closed)

Uses: organic syntheses

Solubility:

insoluble in water

very soluble in alcohol and ether

Additional Data: vapor density, 6.83

## 1-TETRADECANETHIOL

Synonyms:

myristyl mercaptan

tetradecyl mercaptan

Formula:  $C_{13}H_{27}CH_2SH$ 

Formula Weight: 230.4

Melting Point: 6.5° C.Boiling Point: 176 to 180° C. (at 22 mm.)Specific Gravity: 0.8398(25/4)Refractive Index: 1.4612

## 1-TETRADECENE

Synonyms:  $\alpha$ -tetradecyleneFormula:  $CH_2:CH(CH_2)_{11}CH_3$ 

Formula Weight: 196.4

Melting Point: -12° C.

Boiling Point:

246° C. (at 760 mm.)

127° C. (at 15 mm.)

Specific Gravity:

0.755(15/4)                      0.772(20/4)Refractive Index: 1.4365

Solubility:

insoluble in water

very soluble in alcohol and ether

## TETRADECYL ACETATE

Synonyms: acetic acid tetradecyl ester

Formula:  $CH_3COOC_{14}H_{29}$ 

Formula Weight: 256.4

Melting Point: 12 to 13° C.

Boiling Point: 176 to 177° C. (at 15 mm.)

## 2-TETRADECYNE

Formula:  $CH_3C:C(CH_2)_{10}CH_3$ 

Formula Weight: 194.4

Melting Point: 5.5 to 6.5° C.

Boiling Point:

252.5° C. (at 760 mm.)

134° C. (at 15 mm.)

Specific Gravity:

0.800(15/4)                      0.765(20/4)

Solubility:

insoluble in water

very soluble in alcohol and ether

## 1,2,3,4-TETRAETHYLBENZENE

Formula:  $(C_2H_5)_4C_6H_2$ 

Formula Weight: 190.3

Melting Point: 11.6° C.

Boiling Point:

248° C. (at 760 mm.)

254° C. (at 760 mm.)

Specific Gravity: 0.887(20/4)

Refractive Index: 1.5083

Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## 1,2,4,5-TETRAETHYLBENZENE

Formula:  $(C_2H_5)_4C_6H_2$ 

Formula Weight: 190.3

Melting Point: 13° C.

Boiling Point: 250° C. (at 760 mm.)

Specific Gravity: 0.888(16/4)

Refractive Index: 1.5025

Solubility:

insoluble in water

very soluble in alcohol and ether

#### TETRAETHYLENE GLYCOL

Formula:  $\text{CH}_2\text{OH}(\text{CH}_2\text{OCH}_2)_3\text{CH}_2\text{OH}$

Characteristics:

hygroscopic colorless liquid

Formula Weight: 194.2

Boiling Point:

327 to 328° C. (at 760 mm.)

307.8° C. (at 760 mm.)

327.3° C. (at 760 mm.)

Vapor Pressure (mm. Hg):

<0.001 at 20° C.

Specific Gravity:

1.125(20/20)

9.4 lbs. per gal. at 20° C.

Flash Point: 345° F. (open)

Uses:

coating compositions

heat transfer medium

lacquers plasticizers

solvent for nitrocellulose

Solubility:  $\infty$  (in water)

#### TETRAETHYLENE GLYCOL DIBUTYL ETHER

Synonyms:

dibutoxytetraethylene glycol

dibutoxytetraglycol

Formula:  $\text{C}_4\text{H}_9\text{O}(\text{C}_2\text{H}_4\text{O})_4\text{C}_4\text{H}_9$

Formula Weight: 306.4

Freezing Point: -20.0° C.

Boiling Point:

330.0° C. (at 760 mm.)

237° C. (at 50 mm.)

204.0° C. (at 5 mm.)

Specific Gravity:

0.9436(20/20)

7.85 lbs. per gal. at 20° C.

Refractive Index: 1.4537

Vapor Pressure (mm. Hg): <0.01 at 20° C.

Absolute Viscosity (centipoises):

5.7 at 20° C.

Flash Point: 335° C. (open)

Uses:

inert reaction or extraction medium

lubricant solvent

plasticizer

Solubility (per cent by weight at 20° C.):

4.8 (of water) 1.3 (in water)

completely miscible with alcohol,

acetone, 1,2-dichloroethane, ethyl

acetate, toluene, heptane, castor oil,

pine oil, and isopropyl ether

Additional Data:

100 ml. dissolve about 50 grams of the  
insecticide DDT (dichlorodiphenyl-  
trichlorethane)

#### TETRAETHYLENE GLYCOL DIMETHYL ETHER

Synonyms:

dimethoxytetraethylene glycol

dimethoxytetraglycol

2,5,8,11,14-pentoxapentadecane

Formula:  $(\text{CH}_3\text{OC}_2\text{H}_4\text{OC}_2\text{H}_4)_2\text{O}$

Characteristics: mild odor

Formula Weight: 222.3

Freezing Point: -21.4° C.

Boiling Point:

275.8° C. (at 760 mm.)

184.0° C. (at 50 mm.)

146° C. (at 5 mm.)

Specific Gravity:

1.0132(20/20)

8.43 lbs. per gal. at 20° C.

Refractive Index: 1.4336

Vapor Pressure (mm. Hg): <0.01 at 20° C.

Absolute Viscosity (centipoises):

4.05 at 20° C.

Flash Point: 285° F. (open)

TETRAETHYLENE GLYCOL  
DIMETHYL ETHER (Cont.)

## Uses:

inert reaction or extraction medium  
 lubricant                      reaction medium  
 plasticizer                      rubber lubricant  
 solvent for chlorinated hydrocarbon  
 refrigerants for absorption type  
 refrigerators

## Solubility:

$\infty$  (in water)  
 soluble in alcohol and hydrocarbons  
 it is completely miscible with alcohol,  
 acetone, 1,2-dichloroethane, ethyl  
 acetate, toluene, heptane, castor oil,  
 pine oil, and isopropyl ether

## TETRAETHYLENEPENTAMINE

Formula:  $\text{NH}_2(\text{CH}_2\text{CH}_2\text{NH})_3\text{CH}_2\text{CH}_2\text{NH}_2$ 

## Characteristics:

hygroscopic                      alkaline  
 viscous

Formula Weight: 189.3

Boiling Point:  $333^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.999(20/20)

8.3 lbs. per gal. at  $20^\circ\text{C}$ .Vapor Pressure (mm. Hg): <0.01 at  $20^\circ\text{C}$ .Flash Point:  $325^\circ\text{F}$ . (open)

## Uses:

gas purification and dehydration  
 solvent for acid gases, dyes, resins,  
 and sulfur

## Solubility:

$\infty$  (in water)  
 soluble in most organic solvents

## TETRAETHYLLEAD

## Synonyms:

lead tetraethide                      lead tetraethyl

Formula:  $(\text{C}_2\text{H}_5)_4\text{Pb}$ 

## Characteristics:

agreeable, characteristic odor  
 oily                      toxic  
 absorbed by the skin

Formula Weight:  $323.5^\circ\text{C}$ .Melting Point:  $-136^\circ\text{C}$ .

## Boiling Point:

 $152^\circ\text{C}$ . (at 291 mm.) $198$  to  $202^\circ\text{C}$ . (at 760 mm.) $75$  to  $85^\circ\text{C}$ . (at 13 to 14 mm.)

Specific Gravity: 1.659(18/4)

Refractive Index: 1.5218 at  $18^\circ\text{C}$ .

## Uses:

ethylating agent  
 antiknock agent for internal combustion  
 engines

## Solubility:

insoluble in water, dilute alkalies, and  
 dilute acids  
 slightly soluble in alcohol  
 soluble in benzene and most organic  
 solvents  
 $\infty$  (in ether)

## TETRAETHYLSILICANE

Synonyms: silicon tetraethyl

Formula:  $(\text{C}_2\text{H}_5)_4\text{Si}$ 

Formula Weight: 144.3

Boiling Point:  $152$  to  $154^\circ\text{C}$ . (at 760 mm)

Specific Gravity: 0.7682(22/4)

Solubility: insoluble in water

## TETRAETHYLTIN

## Synonyms:

tetraethyl stannate      tin tetraethyl

Formula:  $\text{Sn}(\text{C}_2\text{H}_5)_4$ 

Formula Weight: 234.9

Melting Point:  $-112^\circ\text{C}$ .Boiling Point:  $181^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

 $1.187$  at  $22^\circ\text{C}$ . $1.199(20/4)$ 

Refractive Index: 1.5143

## Solubility:

insoluble in water      soluble in alcohol  
 soluble in ether

## TETRAETHYLUREA

Formula:  $(C_2H_5)_2NCON(C_2H_5)_2$ 

Formula Weight: 172.3

Boiling Point: 210 to 215°C. (at 760 mm.)

Specific Gravity: 0.886(20/4)

Solubility:

insoluble in water and in alkalies  
soluble in acids

## TETRAHYDROFURAN

Synonyms: tetramethylene oxide

Formula:  $OCH_2CH_2CH_2CH_2$ 

Characteristics:

ether-like odor      mobile

Formula Weight: 72.1

Melting Point: -65°C.

Boiling Point:

64 to 66°C. (at 760 mm.)

63 to 68°C. (at 760 mm.)

Specific Gravity:

0.8880(20/4)

0.8840 to 0.8890(20/4)

Refractive Index:

1.4040 at 25°C.

1.4045 to 1.4075 at 20°C.

Flash Point:

800 F. (closed)

700 F. (open)

Uses:

solvent for cellulose esters and ethers,  
vinyl acetals, chloride and acetate  
polymers, alkyd resins, synthetic  
rubber and natural resins, and oils  
Grignard reaction and other organic  
syntheses  
refining lubricating oils

Solubility:

very soluble in water  
soluble in alcohol and ether  
miscible with most common organic  
solvents

Additional Data:

continued exposure to air causes slow  
formation of unstable peroxides  
do not distill without testing for  
peroxides; if present, remove  
peroxides by shaking with or distill-  
ing from a 0.5 to 1% NaOH solution  
azeotrope with water contains 6% of  
water and boils at 62.2°C.

## TETRAHYDROFURFURYL ACETATE

Synonyms:

acetic acid tetrahydrofurfuryl ester

Formula:  $CH_3COOCH_2C_4H_7O$ 

Formula Weight: 144.2

Boiling Point:

194 to 195°C. (at 753 mm.)

192 to 194°C. (at 740 mm.)

91 to 92°C. (at 16 mm.)

84 to 86°C. (at 14 mm.)

Specific Gravity:

1.062(25/4)

1.061(20/20)

Solubility:

slightly soluble in water  
soluble in alcohol, ether, and  
chloroform

## TETRAHYDROFURFURYL ADIPATE

Synonyms:

adipic acid tetrahydrofurfuryl ester

Formula:  $C_6H_5COOCH_2C_4H_7O$ 

Formula Weight: 206.2

Boiling Point: 143 to 145°C. (at 3 mm.)

Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## TETRAHYDROFURFURYL ALCOHOL

Synonyms:

2-furanmethanol  
tetrahydrofurylcarbinolFormula:  $C_4H_7OCH_2OH$

TETRAHYDROFURFURYL ALCOHOL  
(Cont.)

## Characteristics:

odorless to pale yellow  
mobile

Formula Weight: 102.1

## Boiling Point:

170 to 180°C. (at 760 mm.)  
119 to 204°C. (at 760 mm.)  
177 to 178°C. (at 743 mm.)

## Specific Gravity:

1.050(20/4)                      1.051 at 20°C.  
1.052(25/25)                      8 lbs. per gal.

Refractive Index: 1.4052 at 25°C.

Surface Tension (in dynes per cm.):  
36.5 at 20°C.

Vapor Pressure (mm. Hg): <1 at 30°C.

Viscosity (centipoises): 5.49 at 25°C.

Flash Point: 180°F. (closed)

## Uses:

brake fluid                      plasticizers  
electrolytic condenser medium  
antistatic agent for cellulosic yarns  
manufacture of esters  
stabilization of gelatin solution  
solvent for dyes and resins

## Solubility:

∞ (in water, alcohol and ether)  
miscible with most organic solvents

## Additional Data:

coefficient of expansion,  
0.00074 at 10 to 30°C.  
dilution ratios:  
with xylene, 2.6  
with mineral spirits, immiscible

## TETRAHYDROFURFURYL BENZOATE

## Synonyms:

benzoic acid tetrahydrofurfuryl ester

Formula:  $C_6H_5COOCH_2C_4H_7O$

Formula Weight: 206.2

## Boiling Point:

300 to 302°C. (at 750 mm.)  
143 to 145°C. (at 3 mm.)  
138 to 140°C. (at 2 mm.)

Specific Gravity: 1.137(20/0)

## Solubility:

insoluble in water  
soluble in alcohol, ether, and  
chloroform

## TETRAHYDROFURFURYL BUTYRATE

## Synonyms:

butyric acid tetrahydrofurfuryl ester

Formula:  $C_3H_7COOCH_2C_4H_7O$

Formula Weight: 172.2

Boiling Point: 225 to 227°C. (at 760 mm.)

Specific Gravity: 1.012(20/0)

## TETRAHYDROFURFURYL CAPROATE

## Synonyms:

caproic acid tetrahydrofurfuryl ester

Formula:  $C_5H_{11}COOCH_2C_4H_7O$

Formula Weight: 200.3

Boiling Point: 141.3°C. (at 19 mm.)

## Solubility:

insoluble in water  
soluble in alcohol and ether

## TETRAHYDROFURFURYL LACTATE

## Synonyms:

lactic acid tetrahydrofurfuryl ester

Formula:  $CH_3CHOHCOOCH_2C_4H_7O$

Characteristics: yellow

Formula Weight: 174.2

Boiling Point: 146 to 149°C. (at 18 mm.)

## Solubility:

soluble in water, alcohol and ether

## TETRAHYDROFURFURYL LAURATE

## Synonyms:

lauric acid tetrahydrofurfuryl ester

Formula:  $C_{11}H_{23}COOCH_3C_4H_7O$

Characteristics: pale yellow

Formula Weight: 284.4

Boiling Point: 184 to 186° C. (at 6 mm.)

Solubility:

insoluble in water

soluble in alcohol and ether

#### TETRAHYDROFURFURYL MALEATE

Synonyms:

maleic acid tetrahydrofurfuryl ester

Formula:  $(CHCOOCH_2C_4H_7O)_2$

Characteristics:

yellow

viscous

Formula Weight: 284.4

Boiling Point: 190 to 193° C. (at 2 mm.)

Solubility:

slightly soluble in water

soluble in alcohol and ether

#### TETRAHYDROFURFURYL OLEATE

Synonyms:

oleic acid tetrahydrofurfuryl ester

Formula:  $C_4H_7OCH_2OCC_{17}H_{33}$

Characteristics:

yellow to brown oily

characteristic fatty acid color

Formula Weight: 366.5

Pour Point: -22° C.

Boiling Point: 200 to 285° C. (at 16 mm.)

Specific Gravity: 0.931(15.5/15.5)

Refractive Index: 1.4650

Flash Point: 390° F. (closed)

Uses:

plasticizer for film forming materials

Solubility:

insoluble in water

soluble in alcohol and ether

soluble in alcohols, esters, ketones,

hydrocarbons and chlorinated solvents

compatible with benzyl cellulose,  
gilsonite, nitrocellulose, polystyrene,  
and polyvinyl acetate

Additional Data: fire point, 467.2° F.

#### TETRAHYDROFURFURYL PALMITATE

Synonyms:

palmitic acid tetrahydrofurfuryl ester

Formula:  $C_{15}H_{31}COOCH_2C_4H_7O$

Characteristics: pale yellow

Formula Weight: 340.5

Boiling Point: 195 to 198° C. (at 1.5 mm.)

Solubility:

insoluble in water

soluble in alcohol and ether

#### TETRAHYDROFURFURYL PROPIONATE

Synonyms:

propionic acid tetrahydrofurfuryl ester

Formula:  $CH_3CH_2COOCH_2C_4H_7O$

Formula Weight: 158.2

Boiling Point:

204 to 207° C. (at 756 mm.)

100 to 102° C. (at 18 mm.)

Specific Gravity: 1.044(20/4)

Solubility:

insoluble in water

soluble in alcohol and ether

#### TETRAHYDROFURFURYL SALICYLATE

Synonyms:

salicylic acid tetrahydrofurfuryl ester

Formula:  $HOC_6H_4COOCH_2C_4H_7O$

Characteristics: pale yellow

Formula Weight: 222.2

Boiling Point: 131 to 133° C. (at 2 mm.)

Solubility:

insoluble in water

soluble in alcohol and ether

## TETRAHYDROFURFURYL SUCCINATE

## Synonyms:

succinic acid tetrahydrofurfuryl ester

Formula:  $(\text{CH}_2\text{COOCH}_2\text{C}_4\text{H}_7\text{O})_2$ 

Characteristics: pale yellow

Formula Weight: 286.3

Boiling Point: 219 to 221°C. (at 9 mm.)

## Solubility:

insoluble in water

soluble in alcohol and ether

## 1,2,3,4-TETRAHYDRO-1-NAPHTHOL

## Synonyms:

 $\alpha$ -naphthol-1,2,3,4-tetrahydride  
act-tetrahydro-2-naphtholFormula:  $\text{C}_6\text{H}_4:\text{C}_4\text{H}_7\text{OH}$ 

Formula Weight: 184.2

Boiling Point: 140°C. (at 17 mm.)

Specific Gravity: 1.090

Refractive Index: 1.5671 at 17°C.

## Solubility:

very slightly soluble in water

very soluble in alcohol and ether

## 1,2,3,4-TETRAHYDRO-2-NAPHTHOL

## Synonyms:

 $\beta$ -naphthol-1,2,3,4-tetrahydride  
act-tetrahydro- $\beta$ -naphtholFormula:  $\text{C}_6\text{H}_4:\text{C}_4\text{H}_7\text{OH}$ 

Characteristics: oily

Formula Weight: 148.2

Boiling Point: 265.5°C. (at 760 mm.)

Specific Gravity: 1.071(20/4)

## Solubility:

very slightly soluble in water

very soluble in alcohol and ether

TETRAHYDRO-act- $\alpha$ -  
NAPHTHYLAMINEFormula:  $\text{C}_6\text{H}_4\text{CH}(\text{NH}_2)(\text{CH}_2)_2\text{CH}_2$ 

Characteristics: oily

Formula Weight: 147.2

Boiling Point: 246.5°C. (at 714 mm.)

## Solubility:

soluble in hot water, alcohol, and ether

TETRAHYDRO- $\alpha$ -NAPHTHYLAMINE

## Synonyms:

5,6,7,8-tetrahydro-1-naphthylamine

Formula:  $(\text{CH}_2)_4:\text{C}_6\text{H}_3\text{NH}_2$ 

Characteristics: oily

Formula Weight: 147.2

Boiling Point: 275°C. (at 12 mm.)

## Specific Gravity:

1.067(15/15) 1.054 at 23°C.

Refractive Index: 1.5896 at 23°C.

## Solubility:

very slightly soluble in water

soluble in alcohol, ether, and dilute  
acidsTETRAHYDRO-act- $\text{dl}$ - $\beta$ -  
NAPHTHYLAMINEFormula:  $\text{C}_6\text{H}_4\text{CH}_2\text{CH}(\text{NH}_2)\text{CH}_2\text{CH}_2$ 

Formula Weight: 147.2

## Boiling Point:

250°C. (at 710 mm.)

with slight decomposition

Specific Gravity: 1.034(15/15)

## Solubility:

slightly soluble in hot water, alcohol,  
and ether

## TETRAHYDROPYRAN

## Synonyms: pentamethylene oxide

Formula:  $\text{O}(\text{CH}_2)_4\text{CH}_2$

## Characteristics:

ether-like odor      mobile

Formula Weight: 86.1

## Boiling Point:

81 to 82° C. (at 760 mm.)

88° C. (at 760 mm.)

## Specific Gravity:

0.8540

0.8814(20/4)Refractive Index: 1.420Flash Point: -4° F. (closed)

## Uses:

lacquers

organic syntheses

plastics

solvent for alcohol-soluble phenolic  
resins, cellulose acetate, chlorinated  
rubber, chlorinated polyvinyl  
chloride, ester gum, ethyl cellulose,  
manila copal, polystyrene, rosin,  
shellac, vinyl chloride copolymers,  
and vinylidene chloride copolymers

## Solubility:

soluble in water

∞ (in alcohol and ether)

miscible with most common organic  
solvents

## Additional Data:

do not use without testing for and  
removal of peroxides  
keep away from heat and open flames  
use with enough ventilation  
avoid prolonged or repeated breathing  
of vapors and contact with skin

## 1,2,3,4-TETRAHYDROQUINOLINE

Formula:  $C_9H_{10}NH$ 

Characteristics: colorless to yellow

Formula Weight: 133.2

Melting Point: 20° C.

Boiling Point: 251° C. (at 760 mm.)

Specific Gravity:

1.055

1.0704 at 4° C.

Refractive Index: 1.59331 at 23.9° C.

## Solubility:

very slightly soluble in water

∞ (in alcohol)      ∞ (in ether)

## TETRAISOAMYL TIN

Synonyms: tetraisoamylstannane

Formula:  $[(CH_3)_2CHCH_2CH_2]_4Sn$ 

Formula Weight: 403.3

Boiling Point: 188° C. (at 24 mm.)

Specific Gravity: 1.035 at 19.6° C.

## 1,2,4,5-TETRAISOPROPYLBENZENE

Formula:  $[(CH_3)_2CH]_4C_6H_2$ 

Formula Weight: 246.4

Boiling Point: 260° C. (at 760 mm.)

Solubility (grams per 100 ml.):

insoluble in water

1 at 25° C. (in alcohol)

85 at 25° C. (in ether)

## TETRALIN

Synonyms:

naphthalene 1,2,3,4-tetrahydride

1,2,3,4-tetrahydronaphthalene

Formula:  $C_{10}H_8$ 

Characteristics: pungent odor

Formula Weight: 132.2

Melting Point:

-30 to -31.0° C.

-45 to -25° C.

Boiling Point:

206 to 207° C. (at 764 mm.)

207.2° C. (at 760 mm.)

196 to 217° C. (at 760 mm.)

206 to 215° C. (at 760 mm.)

Specific Gravity:

0.971

0.973(18/4)

0.970 to 0.975 at 20° C.

0.981 at 30° C.8.10 lbs. per gal. at 20° C.Vapor Pressure (mm. Hg): <1 at 30° C.

## TETRALIN (Cont.)

## Refractive Index:

1.54614 at 20.2° C. 1.540 to 1.547Viscosity (S.U.V. at 100° F.): 32

## Flash Point:

171° F. (closed) 180° F. (open)

## Uses:

agricultural sprays  
 bituminous emulsions  
 extracting sulfur in gas purification  
 extracting casinghead gasoline from natural gas  
 floor polishes            motor fuels  
 coal gas purification  
 paint and varnishes  
 waterproofing  
 solvent for asphalts, benzene, casing-head gasoline, cellulose ethers, ethers, gums, greases, naphthalene, oils, resins, rubber, soaps, and waxes

## Solubility:

insoluble in water  
 water is insoluble in tetralin  
 very soluble in alcohol and ether  
 $\infty$  (in benzene)       $\infty$  (in acetone)  
 miscible with most organic solvents

## Additional Data:

evaporation rate is considerably slower than that of turpentine or high flash naphtha  
 vapor density, 4.55  
 coefficient of expansion, 0.00083 at 10 to 30° C.

## 2,3,4,6-TETRAMETHYLANILINE

## Synonyms:

4-aminoisodurene    isoduridine  
 2,3,4,6-tetramethylaminobenzene

Formula:  $(\text{CH}_3)_4\text{C}_6\text{HNH}_2$ 

Formula Weight: 149.2

Melting Point: 23 to 24° C.

Boiling Point: 253 to 255° C. (at 760 mm.)

Specific Gravity: 0.978 at 24° C.

Solubility: soluble in alcohol

 $\alpha, \delta$ -TETRAMETHYLDIAMINOBTANE

## Formula:

 $(\text{CH}_3)_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N}(\text{CH}_3)_2$ 

Formula Weight: 144.3

Boiling Point: 169° C. (at 760 mm.)

Specific Gravity: 0.804(19/4)

## Solubility:

$\infty$  (in water)  
 soluble in alcohol and ether

## TETRAMETHYLLEAD

## Synonyms:

lead tetramethyl  
 tetramethylplumbane

Formula:  $\text{Pb}(\text{CH}_3)_4$ 

Formula Weight: 267.4

Melting Point: -27.5° C.

Boiling Point: 110.0° C. (at 760 mm.)

Specific Gravity: 1.9951(20/4)

Refractive Index: 1.5128

Inflammability (volume per cent in air):  
 1.8 (lower limit)

## Solubility:

insoluble in water  
 $\infty$  (in alcohol and ether)

Additional Data: vapor density, 3.20

## 2,4,5,7-TETRAMETHYLOCTANE

## Synonyms: dodecane

Formula:  $\text{C}_{12}\text{H}_{26}$ 

Characteristics: oily

Formula Weight: 170.3

Boiling Point: 208 to 210° C. (at 760 mm.)

Solubility: soluble in ligroin

## TETRAMETHYLSILICANE

## Synonyms:

silicon methyl  
 silicon tetramethyl  
 tetramethylsilicon

Formula:  $(\text{CH}_3)_4\text{Si}$

Formula Weight: 88.2

Melting Point:  $-102.1^\circ\text{C}$ .

Boiling Point:

27.00°C. (at 760 mm.)

26 to 27°C. (at 761 mm.)

Specific Gravity:

0.648(19/4)

0.645(20/4)

Solubility:

insoluble in water and in sulfuric acid  
very soluble in alcohol and ether

Additional Data:

ignites in air

critical temperature,  $185^\circ\text{C}$ .

critical pressure, 33 atm.

#### TETRAMETHYLTIN

Synonyms:

tetramethylstannane

tin tetramethyl

Formula:  $(\text{CH}_3)_4\text{Sn}$

Formula Weight: 178.8

Boiling Point:  $78.0^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.291(26/4)

1.314(0/4)

Refractive Index: 1.5201

Inflammability (volume per cent in air):

1.9 (lower limit)

Solubility:

insoluble in water

soluble in alcohol and ether

#### TETRAMETHYLUREA

Formula:  $(\text{CH}_3)_2\text{NCON}(\text{CH}_3)_2$

Formula Weight: 116.2

Boiling Point:  $177^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.972 at  $15^\circ\text{C}$ .

Solubility:

very soluble in alcohol and ether

#### TETRANITROMETHANE

Formula:  $\text{C}(\text{NO}_2)_4$

Formula Weight: 196.0

Melting Point:  $13^\circ\text{C}$ .

Boiling Point:

$125.7^\circ\text{C}$ . (at 760 mm.)

with slight decomposition

Specific Gravity: 1.650(13/4)

Refractive Index:

1.43976 at  $16.9^\circ\text{C}$ . (He)

Solubility:

insoluble in water

soluble in alcohol and ether

#### TETRAPROPYLTIN

Synonyms: tetrapropylstannane

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2)_4\text{Sn}$

Formula Weight: 291.1

Boiling Point: 222 to  $225^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.1065 at  $20.2^\circ\text{C}$ .

Solubility:

insoluble in water

soluble in common organic solvents

#### TETRA-o-TOLYLTIN

Synonyms: tetra-o-tolylstannane

Formula:  $(\text{CH}_3\text{C}_6\text{H}_4)_4\text{Sn}$

Formula Weight: 483.2

Boiling Point: 158 to  $159^\circ\text{C}$ . (at 760 mm.)

Solubility:

insoluble in water and alcohol

soluble in ether and benzene

#### 2-THIABUTANE

Formula:  $\text{C}_3\text{H}_8\text{S}$

Formula Weight: 76.1

Melting Point:  $-105^\circ\text{C}$ .

Boiling Point:  $66^\circ\text{C}$ . (at 760 mm.)

## 2-THIABUTANE (Cont.)

Specific Gravity:  
0.841 at 20°C.      0.836 at 25°C.  
Refractive Index: 1.440

## THIACYCLOBUTANE

Formula:  $C_3H_6S$   
Formula Weight: 74.1  
Melting Point: -64°C.  
Boiling Point: 94°C. (at 760 mm.)  
Specific Gravity:  
1.020 at 20°C.      1.016 at 25°C.  
Refractive Index: 1.507

## THIACYCLOHEXANE

Formula:  $C_5H_{10}S$   
Formula Weight: 102.1  
Melting Point: 13°C.  
Boiling Point: 141°C. (at 760 mm.)  
Specific Gravity:  
0.986 at 20°C.      0.982 at 25°C.  
Refractive Index: 1.504

## 6-THIAHENDECANE

Synonyms: 6-thiaundecane  
Formula:  $C_{10}H_{22}S$   
Formula Weight: 174.2  
Melting Point: -51°C.  
Boiling Point:  
229°C. (at 760 mm.)  
101°C. (at 10 mm.)  
Specific Gravity:  
0.839 at 20°C.      0.835 at 25°C.  
Refractive Index:  
1.4559      1.4534 at 25°C.

## 4-THIA-1,6-HEPTADIENE

Formula:  $C_6H_{10}S$   
Formula Weight: 114.4

Melting Point: -83°C.  
Boiling Point: 139°C. (at 760 mm.)  
Specific Gravity: 0.893 at 20°C.  
Refractive Index: 1.491

## 4-THIAHEPTANE

Formula:  $C_6H_{14}S$   
Formula Weight: 118.2  
Melting Point: -102°C.  
Boiling Point: 141°C. (at 760 mm.)  
Specific Gravity:  
0.840 at 20°C.      0.836 at 25°C.  
Refractive Index:  
1.449      1.446 at 25°C.

## 5-THIANONE

Formula:  $C_8H_{18}S$   
Formula Weight: 146.2  
Melting Point: -80°C.  
Boiling Point: 185°C. (at 760 mm.)  
Specific Gravity:  
0.837 at 20°C.      0.833 at 25°C.  
Refractive Index:  
1.453      1.451 at 25°C.

## 3-THIAPENTANE

Formula:  $C_4H_{10}S$   
Formula Weight: 90.1  
Melting Point: -102°C.  
Boiling Point: 91.8°C. (at 760 mm.)  
Specific Gravity:  
0.836 at 20°C.      0.832 at 25°C.  
Refractive Index:  
1.4423      1.4388 at 25°C.

## 2-THIAPROPANE

Formula:  $C_2H_6S$   
Formula Weight: 62.1

Melting Point:  $-83^{\circ}\text{C}$ .

Boiling Point:  $37.5^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  
0.846 at  $20^{\circ}\text{C}$ .      0.843 at  $25^{\circ}\text{C}$ .

Refractive Index: 1.436

### THIAZOLE

Synonyms:  
methathiazole      thiomonazole

Formula:  $\text{SCH:NCH:CH}$

Formula Weight: 85.1

Boiling Point:  $116.8^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  
1.200(17/4)      1.198

Solubility:  
slightly soluble in water  
soluble in alcohol and ether

### THIOCYANIC ACID

Synonyms: sulfocyanic acid

Formula: CNSH

Formula Weight: 59.1

Melting Point:  $5^{\circ}\text{C}$ .

Boiling Point: decomposes

Solubility:  
 $\infty$  (in water with decomposition)  
very soluble in alcohol and ether

### 2,2'-THIODIETHANOL

Synonyms:

bis- $\beta$ -hydroxyethyl sulfide  
 $\beta, \beta'$ -dihydroxydiethyl sulfide  
di-2-hydroxyethyl sulfide  
"Kromfax" solvent  
thiodiethylene glycol  
 $\beta$ -thiodiglycol

Formula:  $(\text{HOCH}_2\text{CH}_2)_2\text{S}$

Characteristics:  
hygroscopic      nearly colorless  
syropy

Formula Weight: 122.2

Melting Point:

$-16^{\circ}\text{C}$ .

freezing point:

$-11.2^{\circ}\text{C}$ .

$-10^{\circ}\text{C}$ .

Boiling Point:

$282.0^{\circ}\text{C}$ . (at 760 mm.)

$194^{\circ}\text{C}$ . (at 50 mm.)

164 to  $166^{\circ}\text{C}$ . (at 20 mm.)

$168^{\circ}\text{C}$ . (at 14 mm.)

Specific Gravity:

1.1847(20/20)

1.1824(20/4)

9.9 lbs. per gal. at  $20^{\circ}\text{C}$ .

1.1810 to 1.1860(20/20)

9.853 lbs. per gal. at  $20^{\circ}\text{C}$ .

Refractive Index:

1.519

1.5217

1.5213

Vapor Pressure (mm. Hg):  $<0.01$  at  $20^{\circ}\text{C}$ .

Viscosity (centipoises): 65.2 at  $20^{\circ}\text{C}$ .

Flash Point:  $320^{\circ}\text{F}$ . (open)

Uses:

solvent for acid, basic and vat dyes

Solubility:

$\infty$  (in water and alcohol)  
slightly soluble in ether  
soluble in chloroform

Additional Data:

hydrochloric acid or compounds  
generating hydrochloric acid should  
not be used with this solvent as such  
combinations generate toxic products

### THIOLACETIC ACID

Synonyms:

ethanethiolic acid  
methanecarbothiolic acid  
thioacetic acid

Formula:  $\text{CH}_3\text{COSH}$

Characteristics:

pungent odor of acetic acid and  
hydrogen sulfide  
yellow

Formula Weight: 76.1

Melting Point:  $<-17^{\circ}\text{C}$ .

## THIOLACETIC ACID (Cont.)

Boiling Point: 93° C. (at 760 mm.)

Specific Gravity: 1.074(10/4)

## Uses:

chemical laboratory reagent

## Solubility:

soluble in water

∞ (in alcohol and ether)

## THIOLBENZOIC ACID

## Synonyms:

benzenecarbothioic acid

thiobenzoic acid

 Formula:  $C_6H_5COSH$ 

## Characteristics:

yellow oily

Formula Weight: 138.2

Melting Point: 24° C.

Boiling Point: decomposes

## Solubility:

insoluble in water

∞ (in alcohol and ether)

## THIOPHENE

## Synonyms: thiofuran

 Formula:  $SCH:CHCH:CH$ 

## Characteristics: mobile

Formula Weight: 84.1

## Melting Point:

-38.3° C. -40° C.

-38 to -36° C. -37° C.

-30° C.

## Boiling Point:

84.0 to 84.4° C. (at 760 mm.)

83 to 85° C. (at 760 mm.)

## Specific Gravity:

1.070(25/4) 1.064(20/4)

1.0884(0/4) 1.0583 at 25° C.

## Refractive Index:

1.5284 to 1.5290 1.5254 at 25° C.

Uses: organic syntheses

## Solubility:

insoluble in water

 soluble in alcohol, benzene, and  
sulfuric acid

## 2-THIOPHENECARBOXALDEHYDE

## Synonyms:

2-formylthiophene

2-thienylformaldehyde

2-thiophenaldehyde

2-thiophenecarbonal

 Formula:  $C_4H_3SCHO$ 

## Characteristics:

yellow oily

Formula Weight: 112.1

Boiling Point: 198° C. (at 760 mm.)

Specific Gravity: 1.215(21/21)

## Solubility:

insoluble in water

very soluble in alcohol and ether

## THIOPHENEMETHANOL

## Synonyms:

*d*-thenyl alcohol

 2- or *d*-thienylcarbinol

2-thiophenecarbinol

 Formula:  $C_4H_3SCH_2OH$ 

Formula Weight: 114.2

Boiling Point: 207° C. (at 760 mm.)

## Solubility:

insoluble in water

very soluble in alcohol and ether

## THIOPHENINE

## Synonyms:

*d*- or 2-aminothiophene

2,3-dihydro-2-iminothiophene

 Formula:  $C_4H_3SNH_2$ 

## Characteristics:

yellow oily

Formula Weight: 99.2

## Boiling Point:

77 to 79° C. (at 11 mm.)

61 to 62° C. (at 1 mm.)

with decomposition

## Solubility:

very soluble in water and alcohol

insoluble in ether

## THIOPHOGENE

## Synonyms:

Lachrymite

thiocarbonyl chloride

Formula:  $\text{CSCl}_2$ 

## Characteristics:

oily

irritating odor

red

Formula Weight: 115.0

Boiling Point: 73.5° C. (at 760 mm.)

Specific Gravity: 1.5085 at 15° C.

Refractive Index: 1.5442

Uses: dye intermediate

## Solubility:

decomposed by water

soluble in alcohol and ether

## Additional Data:

fumes on exposure to air

vapor density, 4 $\alpha$ -THUJONE

Synonyms: 6-ketosabinane

Formula:  $\text{C}_{10}\text{H}_{16}\text{O}$ 

Formula Weight: 152.2

## Boiling Point:

200 to 201° C. (at 760 mm.)

## Specific Gravity:

0.912

0.913 at 20° C.

Refractive Index: 1.4540 at 13.6° C.

## Solubility:

insoluble in water  $\infty$  (in ether)

very soluble in alcohol

 $\beta$ -THUJONE

Synonyms: tanacetone

Formula:  $\text{C}_{10}\text{H}_{16}\text{O}$ 

Formula Weight: 152.2

Boiling Point: 201 to 203° C. (at 760 mm.)

Specific Gravity: 0.916(20/4)

## Solubility:

insoluble in water      soluble in alcohol

## THYMYL ACETATE

Synonyms: acetylthymol

Formula:  $\text{CH}_3\text{COOC}_{10}\text{H}_{13}$ 

Formula Weight: 192.3

Boiling Point: 245° C. (at 757 mm.)

Specific Gravity: 1.009 at 0° C.

## Solubility:

insoluble in water

 $\infty$  (in alcohol, ether, chloroform, and benzene)

## TIGLALDEHYDE

## Synonyms:

 $\alpha$ ,  $\beta$ -dimethylacroleintrans-dimethylacrylic aldehyde

guaiole

2-methyl-2-butenal

Formula:  $\text{CH}_3\text{CH}:\text{C}(\text{CH}_3)\text{CHO}$ 

Formula Weight: 84.1

## Boiling Point:

116.5° C. (at 760 mm.)

115.8° C. (at 739 mm.)

## Specific Gravity:

0.865

0.870(18/4)

Refractive Index: 1.4495

Solubility (grams per 100 ml.):

2.5 (in water)

 $\infty$  (in alcohol and ether)

$\alpha$ -TOLUALDEHYDE

## Synonyms:

ethylalbenzene  
hyacinthin  
phenylacetaldehyde  
phenylacetic aldehyde

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ 

## Characteristics:

intense odor resembling hyacinth  
peach flavor                      viscous  
sweet insipid taste

Formula Weight: 120.1

Melting Point:  $< -10^\circ\text{C}$ .

## Boiling Point:

193 to  $195^\circ\text{C}$ . (at 760 mm.)  
193 to  $194^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

1.027 to 1.032                      1.032

Refractive Index: 1.52546 at  $19.6^\circ\text{C}$ .

Uses: perfumery and flavorings

## Solubility:

very slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## Solubility in Alcohol-Water Mixtures

% Alcohol	Ratio
45	1:1000
70	1:3
90	1:1

m-TOLUALDEHYDE

## Synonyms:

m-methylbenzaldehyde  
3-methylbenzenecarbal  
m-toluylaldehyde

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CHO}$ 

Formula Weight: 120.1

## Boiling Point:

195.5 to  $199^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.019(20/4)

Refractive Index: 1.54068 at  $21.4^\circ\text{C}$ .

## Solubility:

slightly soluble in water  
soluble in alcohol and ether

o-TOLUALDEHYDE

## Synonyms:

o-methylbenzaldehyde  
2-methylbenzenecarbal  
o-toluylaldehyde

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CHO}$ 

Formula Weight: 120.1

## Boiling Point:

195.5 to  $199^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.039(20/4)

Refractive Index: 1.54852 at  $19.0^\circ\text{C}$ .

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

p-TOLUALDEHYDE

## Synonyms:

4- or p-methylbenzaldehyde  
4-methylbenzenecarbal  
p-toluylaldehyde

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CHO}$ 

## Characteristics:

peppery odor                      cherry flavor  
bitter taste

Formula Weight: 120.1

Boiling Point: 204 to 205 (at 760 mm.)

## Specific Gravity:

1.019(16.7/4)                      1.020

Refractive Index: 1.54693 at  $16.6^\circ\text{C}$ .

## Uses:

synthetic almond, apricot, cherry, and  
plum essences

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## TOLUENE

## Synonyms:

methylbenzene                      phenylmethane  
methylbenzol                      toluol

Formula:  $\text{C}_6\text{H}_5\text{CH}_3$

**Characteristics:**

odor like that of benzene  
vapors are less toxic and less  
inflammable than those of benzene

**Formula Weight:** 92.1

**Melting Point:** -95.00 C.

**Boiling Point:**

110.5 to 110.8° C. (at 760 mm.)

109 to 111° C. (at 760 mm.)

**Specific Gravity:**

0.8658(20/4)

0.86234(25/4)

0.869 to 0.873

7.24 lbs. per gal. at 20° C.

specific gravity (in vacuo),  
0.86696(20/4)      0.87193(60/60)° F.

**Refractive Index:**

1.4950      1.49782 at 16.4° C.

1.4962 at 20° C.

**Inflammability Range (volume per cent in air):**

1.27 (lower limit)      7.0 (upper limit)

**Flash Point:**

400° F. (closed)      450° F. (open)

**Specific Heat (Btu./lb. per ° F. at 68° F.):**

0.4041

**Heat of Vaporization (gram-calories per g.):** 86.5

(Btu./lb. at boiling point), 156.2

(Btu./lb. at 77° F.), 177.28

**Uses:**

dye intermediates  
enamels  
explosives  
extraction of alkaloids  
organic syntheses      synthetic perfumes  
rubber cements      stains  
solvent for lacquers, gums, most oils,  
paints, resins, synthetic enamels, and  
leather coatings, some grades of  
cellulose acetate, many types of  
cellulose ethers

**Solubility (in grams per 100 grams of solution):**

0.047 at 16° C. (in water)

0.05 (water in toluene)

soluble in acetone, glacial acetic acid,  
and chloroform  
∞ (in alcohol and ether)

**Additional Data:**

vapor density, 3.14

API gravity (60° F.), ° API, 30.8

azeotrope with water: boiling point,  
84.1° C.

weight per cent toluene, 86.5

coefficient of expansion,

0.000589 per ° F.,

0.00107 at 10 to 30° C.

autoignition temperature, 1026° F.

specific gravity of gas (ideal)

(air = 1.0), 3.1808

aniline equivalent, 15

aniline point, < -22° F.

critical temperature, 320.6° C.

critical pressure, 41.6 atm.

kauri butanol number, 105

total heating values (at 77° F.),

18,245 Btu./lb.,

131,290 Btu./cu. ft. -gas,

**TOLUENE SUBSTITUTE****Synonyms:**

this is a commercial mixture of  
octanes derived from petroleum

**Boiling Point:** 100 to 140° C. (at 760 mm.)

**Specific Gravity:** 0.743

**Refractive Index:** 1.40

**Flash Point:** 300° F. (closed)

**Uses:**

diluent  
solvent for bitumens, rubber, etc.

**o-TOLUENESULFONYL CHLORIDE****Synonyms:**

toluene sulfochloride

o-toluene sulfone chloride

**Formula:** CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>SO<sub>2</sub>Cl

**Characteristics:** oily

**Formula Weight:** 190.6

**Melting Point:** 10° C.

**Boiling Point:** 126° C. (at 10 mm.)

o-TOLUENESULFONYL CHLORIDE  
(Cont.)

Specific Gravity: 1.344 at 17°C.

Uses: organic syntheses

## Solubility:

insoluble in water  
soluble in alcohol and etherTOLUENESULFONYL  
DI-n-BUTYLAMIDEFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SO}_2\text{N}(\text{C}_4\text{H}_9)_2$ 

Characteristics: pale yellow

Formula Weight: 283.4

Boiling Point: 233 to 234°C. (at 20 mm.)

## Solubility:

insoluble in water  
soluble in alcohol and ether

## m-TOLUENETHIOL

## Synonyms:

3-toluenethiol      m-tolyl mercaptan  
thio-m-cresolFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SH}$ 

Formula Weight: 124.2

Melting Point: &lt; -20°C.

## Boiling Point:

195.4°C. (at 760 mm.)  
195 to 200°C. (at 760 mm.)

## Specific Gravity:

1.0625(0/4)      1.052(12/4)

## Solubility:

insoluble in water      ∞ (in ether)  
soluble in alcohol

## o-TOLUENETHIOL

## Synonyms:

2-toluenethiol      o-tolyl mercaptan  
Spthio-o-cresolFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SH}$ 

Formula Weight: 124.2

slightly soluble  
Boiling Point: 15°C.

Boiling Point: 194.3°C. (at 760 mm.)

## Solubility:

insoluble in water      soluble in alcohol  
very soluble in ether

## m-TOLUIDINE

Synonyms: 3- or m-methylaniline

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NH}_2$ 

Characteristics: reddish-brown

Formula Weight: 107.2

Melting Point: -31.5°C.

Boiling Point: 203.3°C. (at 760 mm.)

Specific Gravity: 0.989(20/4)

Refractive Index: 1.57106 at 22.4°C.

## Uses:

dyes      pharmaceuticals  
flotation oils      rubber  
organic chemicals      accelerators

## Solubility:

slightly soluble in water  
∞ (in alcohol)      ∞ (in ether)

## Additional Data:

weight of pure vapor, 4780 mg./l.  
vapor density, 3.7

## o-TOLUIDINE

Synonyms: 2- or o-methylaniline

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NH}_2$ 

## Characteristics:

yellow  
becomes red-brown when exposed to  
air and light

Formula Weight: 107.3

## Melting Point:

α -24.4°C.      β -16.3°C.

Boiling Point: 199.8°C. (at 760 mm.)

Specific Gravity: 0.999 to 1.004(20/4)

Refractive Index: 1.57276

Flash Point: 185°F. (closed)

## Uses:

dyes	pharmaceuticals
flotation oils	rubber
organic chemicals	accelerators

## Solubility (grams per 100 ml.):

1.50 at 25° C. (in water)  
 ∞ (in alcohol)      ∞ (in ether)  
 soluble in dilute acids

## Additional Data:

volatile with steam  
 weight of pure vapor, 4780 mg./l.  
 vapor density, 3.7 to 3.9  
 autoignition temperature, 900° F.

m-TOLUNITRILE

## Synonyms:

3-methylbenzenecarbonitrile  
m-methylbenzonitrile  
3-tolyl cyanide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CN}$ 

Formula Weight: 117.1

Melting Point: -23° C.

## Boiling Point:

214° C. (at 760 mm.)  
 210° C. (at 773 mm.)

## Specific Gravity:

0.976 at 15° C.      0.986(25/4)

## Solubility (grams per 100 ml.):

0.085 (in cold water)  
 1.67 (in hot water)  
 ∞ (in alcohol)      ∞ (in ether)

o-TOLUNITRILE

## Synonyms:

2-methylbenzenecarbonitrile  
o-methylbenzonitrile  
2-tolyl cyanide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CN}$ 

Formula Weight: 117.1

Melting Point: -14 to -13° C.

## Boiling Point:

204 to 205.2° C. (at 760 mm.)

## Specific Gravity:

0.998(15/15)      0.9941(25/4)

Refractive Index: 1.52720 at 23.1° C.

## Solubility:

insoluble in water      ∞ (in alcohol)  
                                  ∞ (in ether)

a-TOLUNITRILE

## Synonyms:

benzyl cyanide      phenylacetoneitrile

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{CN}$ 

Formula Weight: 117.1

Melting Point: -23.8° C.

## Boiling Point:

233.5° C. (at 760 mm.)  
 233 to 234° C. (at 760 mm.)  
 107° C. (at 12 mm.)

## Specific Gravity:

1.015 at 18° C.      1.018(20/4)

Refractive Index: 1.52105 at 25° C.

Uses: organic syntheses

## Solubility:

insoluble in water      ∞ (in alcohol)  
                                  ∞ (in ether)

a-TOLUYL CHLORIDE

Synonyms: phenylacetyl chloride

Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{COCl}$ 

Formula Weight: 154.6

## Boiling Point:

170° C. (at 250 mm.)  
 94 to 95° C. (at 12 mm.)

Specific Gravity: 1.168(20/4)

## Solubility:

decomposed by water and alcohol  
 very soluble in ether

Additional Data: fumes

m-TOLYL ACETATE

## Synonyms:

m-cresatin      cresyl acetate

m-TOLYL ACETATE (Cont.)

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_4\text{CH}_3$

Formula Weight: 150.2

Boiling Point:  $212^\circ\text{C}$ . (at 760 mm.)

Solubility:

soluble in hot water

very soluble in alcohol and ether

o-TOLYL ACETATE

Synonyms: o-cresyl acetate

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_4\text{CH}_3$

Formula Weight: 150.2

Boiling Point:  $208^\circ\text{C}$ . (at 760 mm.)

Solubility:

very slightly soluble in water

very soluble in alcohol and ether

p-TOLYL ACETATE

Synonyms: p-cresyl acetate

Formula:  $\text{CH}_3\text{COOC}_6\text{H}_4\text{CH}_3$

Characteristics:

narcissus odor

honey flavor

sweet taste

Formula Weight: 150.2

Boiling Point: 208 to  $209^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 1.052 to 1.055

Uses:

synthetic honey type essences and perfumes

Solubility:

soluble in alcohol:

1 volume in 12 of 60% alcohol and

3 of 70% alcohol

o-TOLYL BENZOATE

Synonyms: o-cresyl benzoate

Formula:  $\text{C}_6\text{H}_5\text{COOC}_6\text{H}_4\text{CH}_3$

Formula Weight: 212.2

Boiling Point:  $307^\circ\text{C}$ . (at 760 mm.)

Solubility:

insoluble in water

soluble in ether

m-TOLYL CARBINOL

Synonyms:

m-tolylbenzyl alcohol

m-xylyl alcohol

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{OH}$

Formula Weight: 122.2

Melting Point:  $-20^\circ\text{C}$ .

Boiling Point:  $217^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

1.036(0/4)

0.916 at  $17^\circ\text{C}$ .

Solubility (grams per 100 ml.):

5 (in cold water)

soluble in alcohol

soluble in ether

5-m-TOLYLENEDIAMINE

Synonyms:

3,5-diaminotoluene

3,5-toluenediamine

3,5-toluylenediamine

Formula:  $\text{CH}_3\text{C}_6\text{H}_3(\text{NH}_2)_2$

Formula Weight: 122.2

Boiling Point:  $285^\circ\text{C}$ . (at 760 mm.)

Solubility:

soluble in alcohol

soluble in ether

m-TOLYL ISOCYANATE

Synonyms:

isocyanic acid m-tolyl ester

m-tolylcarbonimide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NCO}$

Formula Weight: 133.1

Boiling Point: 195 to  $198^\circ\text{C}$ . (at 760 mm.)

Solubility:

insoluble in water

soluble in alcohol

soluble in ether

o-TOLYL ISOCYANATE

## Synonyms:

isocyanic acid o-tolyl ester  
o-tolylcarbonimide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NCO}$

Characteristics: pale yellow

Formula Weight: 133.1

Boiling Point: 184 to 187°C. (at 760 mm.)

## Solubility:

insoluble in water    soluble in ether  
 decomposed by hot water and by hot  
 alcohol

p-TOLYL ISOCYANATE

## Synonyms:

isocyanic acid p-tolyl ester  
p-tolylcarbonimide

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NCO}$

Formula Weight: 133.1

Boiling Point: 187°C. (at 751 mm.)

m-TOLYL ISOTHIOCYANATE

## Synonyms:

isothiocyanic acid m-tolyl ester  
m-tolyl mustard oil

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NCS}$

Formula Weight: 149.2

Melting Point: <-20°C.

Boiling Point: 244°C. (at 732 mm.)

o-TOLYL ISOTHIOCYANATE

## Synonyms:

isothiocyanic acid o-tolyl ester  
o-tolyl mustard oil

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NCS}$

Formula Weight: 149.2

Boiling Point: 239°C. (at 760 mm.)

Specific Gravity: 1.104(25/25)

## Solubility:

insoluble in water    ∞ (in ether)  
 very soluble in alcohol

p-TOLYL ISOTHIOCYANATE

## Synonyms:

isothiocyanic acid p-tolyl ester  
p-tolyl mustard oil

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{NCS}$

Formula Weight: 149.2

Melting Point: 26°C.

Boiling Point: 237°C. (at 760 mm.)

Specific Gravity: 1.087(25/25)

## Solubility:

decomposed by hot water and by hot  
 alcohol  
 very soluble in alcohol  
 soluble in ether

m-TOLYL PHOSPHATE

## Synonyms:

tri-m-cresyl phosphate  
 tri-m-tolyl phosphate

Formula:  $(\text{CH}_3\text{C}_6\text{H}_4)_3\text{PO}_4$

Formula Weight: 368.4

Boiling Point: 273 to 275°C. (at 17 mm.)

## Solubility:

insoluble in water    soluble in alcohol  
 soluble in ether

o-TOLYL PHOSPHATE

## Synonyms:

tri-o-cresyl phosphate  
 tri-o-tolyl phosphate

Formula:  $(\text{CH}_3\text{C}_6\text{H}_4)_3\text{PO}_4$

Formula Weight: 368.4

## Boiling Point:

410°C. (at 760 mm.)  
 with slight decomposition  
 263 to 265°C. (at 20 mm.)

## Solubility:

insoluble in water  
 very soluble in alcohol, ether, and  
 benzene

Additional Data: toxic

## TOLYL PHOSPHATE

## Synonyms:

Kronitex AA  
tricresyl phosphate

Formula:  $(\text{CH}_3\text{C}_6\text{H}_4)_3\text{PO}_4$

Formula Weight: 368.4

Freezing Point:  $-30^\circ\text{C}$ . (very stiff gel)

## Boiling Point:

$410$  to  $440^\circ\text{C}$ . (at  $760$  mm.)  
 $275$  to  $280^\circ\text{C}$ . (at  $20$  mm.)  
 $235$  to  $255^\circ\text{C}$ . (at  $4$  mm.)

## Specific Gravity:

$1.160(25/25)$   
 $9.73$  lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index:  $1.556$

Flash Point:  $446^\circ\text{F}$ . (closed)

## Uses:

flame retarder  
additive to motor oils and other oils  
for extreme pressure lubrication  
fire retardant for nitrocellulose  
coating compositions  
dopes  
lacquers  
resins  
waterproofing and fireproofing compositions  
excellent solvent plasticizer for nitrocellulose, Parlon, and Vinylite  
does not dissolve cellulose acetate  
dissolves sparingly and plasticizes ethyl cellulose  
solvent for cellulose acetobutyrate, cellulose acetopropionate, congo, dammar, ester gum, mastic, kauri, and "Vinsol"

## Solubility (in per cent):

$0.3$  at  $25^\circ\text{C}$ . (of water)  
 $0.002$  at  $85^\circ\text{C}$ . (in water)  
 $6$  at  $25^\circ\text{C}$ . (in mineral oil)  
 $\infty$  (in gasoline)  
insoluble or limited solubility in certain amines, mineral oil, glycerol, glycols, etc.  
soluble in most other organic liquids

## Additional Data:

fire point, none up to  $625^\circ\text{C}$ .  
volatility at  $105^\circ\text{F}$ .,  
 $0.00\%$  after 24 hours  
 $0.09\%$  after 100 hours  
evaporation rate at  $105^\circ$  (loss/sq.cm.),  
 $0.000$  grams after 24 hours  
 $0.002$  grams after 100 hours  
hydrolysis (refluxed two hours with water),  $0.01\%$   
dilution ratio with toluene,  $3.2$

m-1-TOLYLPYRROLE

Synonyms: m-N-tolylpyrrole

Formula:  $\text{C}_4\text{H}_4\text{NC}_6\text{H}_4\text{CH}_3$

Characteristics: yellow

Formula Weight: 157.2

Boiling Point:  $149$  to  $151^\circ\text{C}$ . (at  $41$  mm.)

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

o-1-TOLYLPYRROLE

Synonyms: o-N-tolylpyrrole

Formula:  $\text{C}_4\text{H}_4\text{NC}_6\text{H}_4\text{CH}_3$

Characteristics: oily

Formula Weight: 157.2

Boiling Point:  $246^\circ\text{C}$ . (at  $760$  mm.)

## Solubility:

very slightly soluble in hot water  
very soluble in alcohol and benzene

## TRIACETIN

## Synonyms:

glycerol triacetate    glyceryl triacetate

Formula:  $(\text{CH}_3\text{COO})_3\text{C}_3\text{H}_5$

Characteristics: oily

Formula Weight: 218.2

Melting Point:  $-78^\circ\text{C}$ .

## Boiling Point:

$258$  to  $259^\circ\text{C}$ . (at  $760$  mm.)  
 $276^\circ\text{C}$ . (at  $760$  mm.)

## Specific Gravity:

1.156 to 1.161(20/4)

9.7 lbs. per gal.

Refractive Index: 1.4306

## Flash Point:

280° F. (closed)      295° F. (open)

## Uses:

camphor substitute for nitrocellulose industries

perfume fixative      plasticizer

solvent for flavors

## Solubility (grams per 100 ml.):

7.17 (in water)

∞ (in alcohol, ether, chloroform, and benzene)

very soluble in common organic solvents

Additional Data: vapor density, 7.52

## TRIAMYLAMINE

Synonyms: tri-n-amylamineFormula:  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2)_3\text{N}$ 

## Characteristics:

amine odor      light straw color

Formula Weight: 227.4

Boiling Point: 250 to 260° C. (at 760 mm.)

Specific Gravity: 0.793(20/20)

Refractive Index: 1.437

Viscosity (centipoises): 2.42 at 25° C.

Flash Point: 215° F. (open)

## Solubility:

insoluble in water and methanol

soluble in acetone, ether, benzene, gasoline, and ethyl acetate

## Additional Data:

pH of 0.001 N aqueous solution at 25° C. (determined with hydrogen electrode), 9.55

## TRIAMYLAMINE

## Synonyms:

this is a commercial mixture of various isomers

Formula:  $(\text{C}_5\text{H}_{11})_3\text{N}$ 

## Characteristics:

amine odor      yellow

Formula Weight: 227.4

## Boiling Point:

234 to 260° C. (at 760 mm.)7° C. (at 26 mm.)

## Specific Gravity:

0.79 to 0.80 at 20° C.6.61 lbs. per gal.Refractive Index: 1.4374

Surface Tension (dynes per cm.):

24.4 at 13° C.Viscosity (centipoises): 2.42 at 20° C.Flash Point: 215° F. (open)

Specific Heat (gram-calories per g. per ° C.) (liquid):

0.51 at room temperatureHeat of Vaporization (gram-calories per g.): 79

## Uses:

acid corrosion inhibitor

insecticidal compounds

## Solubility:

insoluble in water and methanol

soluble in ether, acetone, benzene, gasoline, and ethyl acetate

## Additional Data:

coefficient of expansion,

0.00091 per ° C.

## TRIAMYLBENZENE

Formula:  $(\text{C}_5\text{H}_{11})_3\text{C}_6\text{H}_3$ 

Characteristics: aromatic odor

Formula Weight: 285.5

Freezing Point: -60° C.Boiling Point: 300 to 320° C. (at 760 mm.)Specific Gravity: 0.87(20/20)Refractive Index: 1.487Viscosity (centipoises): 16.3 at 25° C.

TRIAMYL BENZENE (Cont.)

Flash Point:  $270^{\circ}\text{F.}$  (open)

Solubility:

insoluble in water and methanol  
soluble in ether, acetone, benzene,  
gasoline, and ethyl acetate

Additional Data:

coefficient of expansion,  
 $0.00091$  per  $^{\circ}\text{C.}$

TRIAMYL PHOSPHATE

Synonyms:

tri-n-amyl phosphate  
n-amyl phosphate

Formula:  $(\text{C}_5\text{H}_{11})_3\text{PO}_4$

Formula Weight: 308.4

Boiling Point:  $158$  to  $163^{\circ}\text{C.}$  (at 6 mm.)

Specific Gravity:  $0.9497(25/4)$

Solubility:

insoluble in water  
soluble in alcohol, ether, toluene, and  
carbon disulfide

TRIAZOACETIC ACID

Formula:  $(\text{N}:\text{N}):\text{NCH}_2\text{COOH}$

Characteristics: hygroscopic

Formula Weight: 100.1

Melting Point:  $16^{\circ}\text{C.}$

Boiling Point:  $93^{\circ}\text{C.}$  (at 3 mm.)

Specific Gravity:  $1.354$  at  $33^{\circ}\text{C.}$

TRIAZOBENZENE

Synonyms: phenyl azide

Formula:  $\text{C}_6\text{H}_5\text{N}_3$

Characteristics:

yellow oily

Formula Weight: 119.1

Melting Point: expl.

Boiling Point:  $73.5^{\circ}\text{C.}$  (at 24 mm.)

Specific Gravity:  $1.088(20/20)$

Solubility:

insoluble in water  
slightly soluble in alcohol and ether

1,2,3-TRIBROMOBUTANE

Formula:  $\text{CH}_3(\text{CHBr})_2\text{CH}_2\text{Br}$

Formula Weight: 294.8

Boiling Point:  $110$  to  $113^{\circ}\text{C.}$  (at 19 mm.)

Specific Gravity:  $2.190(16/4)$

1,1,2-TRIBROMO-1,2-DICHLOROETHANE

Formula:  $\text{Br}_2\text{CClCHBrCl}$

Formula Weight: 335.7

Melting Point:  $-5^{\circ}\text{C.}$

Boiling Point:  $133^{\circ}\text{C.}$  (at 35 mm.)

Specific Gravity:  $2.626$  at  $21.5^{\circ}\text{C.}$

1,1,2-TRIBROMO-2,2-DICHLOROETHANE

Formula:  $\text{CHBr}_2\text{CCl}_2\text{Br}$

Formula Weight: 335.7

Boiling Point:  $215$  to  $220^{\circ}\text{C.}$  (at 760 mm.)

1,1,2-TRIBROMO-1,2-DIFLUOROETHANE

Formula:  $\text{Br}_2\text{FCCHBrF}$

Formula Weight: 302.8

Boiling Point:  $146^{\circ}\text{C.}$  (at 760 mm.)

Specific Gravity:  $2.603$  at  $20^{\circ}\text{C.}$

Solubility: insoluble in water

1,1,2-TRIBROMOETHANE

Synonyms: vinyl tribromide

Formula:  $\text{CH}_2\text{BrCHBr}_2$

Formula Weight: 266.8

Melting Point:  $-26^{\circ}\text{C.}$

**Boiling Point:**

188.4° C. (at 760 mm.)

178 to 188° C. (at 752 mm.)

**Specific Gravity:** 2.579(20/4)**Refractive Index:** 1.58902**Solubility:** soluble in alcohol**1,1,2-TRIBROMOETHYLENE****Synonyms:**

ethinyl tribromide

ethylene tribromide

**Formula:** CHBr:CHBr**Formula Weight:** 264.8**Boiling Point:**

163 to 164° C. (at 760 mm.)

53 to 55° C. (at 9 mm.)

**Specific Gravity:** 2.708 at 20.5° C.**1,1,2-TRIBROMO-1-FLUOROETHANE****Formula:** CH<sub>2</sub>BrCFBr<sub>2</sub>**Formula Weight:** 284.8**Boiling Point:** 162.7° C. (at 757 mm.)**Specific Gravity:** 2.605 at 17.5° C.**1,1,2-TRIBROMO-2-FLUOROETHANE****Formula:** CHBr<sub>2</sub>CHBrF**Formula Weight:** 284.8**Boiling Point:** 178° C. (at 760 mm.)**Specific Gravity:** 2.674 at 18° C.**1,2,3-TRIBROMO-2-METHYLPROPANE****Formula:** CH<sub>2</sub>BrCHBr(CH<sub>3</sub>)CH<sub>2</sub>Br**Formula Weight:** 294.8**Boiling Point:** 222 to 225° C. (at 760 mm.)**Specific Gravity:** 2.211(14/4)**Solubility:** insoluble in water**1,2,3-TRIBROMOPROPANE****Synonyms:**

allyl tribromide

glycerol tribromohydrin

glyceryl tribromohydrin

tribromohydrin

**Formula:** CH<sub>2</sub>BrCHBrCH<sub>2</sub>Br**Formula Weight:** 280.8**Melting Point:**

16 to 17° C.

16.5° C.

**Boiling Point:**

219 to 221° C. (at 760 mm.)

220.0° C. (at 760 mm.)

**Specific Gravity:** 2.436 at 23° C.**Refractive Index:** 1.584**Solubility:**

insoluble in water

very soluble in alcohol and ether

**1,1,2-TRIBROMO-1,2,2-TRIFLUOROETHANE****Formula:** CBr<sub>2</sub>FCBrF<sub>2</sub>**Formula Weight:** 320.8**Boiling Point:** 117° C. (at 760 mm.)**Specific Gravity:** 2.567 at 7° C.**TRIBUTYL ACETYLCITRATE****Synonyms:**

acetylcitric acid tributyl ester

**Formula:**CH<sub>3</sub>COO(CCOOC<sub>4</sub>H<sub>9</sub>)(CH<sub>2</sub>COOC<sub>4</sub>H<sub>9</sub>)<sub>2</sub>**Characteristics:** odorless**Formula Weight:** 402.5**Specific Gravity:**1.046 at 25° C.8.73 lbs. per gal.**Refractive Index:** 1.4408 at 25.5° C.**Viscosity (Saybolt; 0.062" orifice):**205 seconds**Uses:**

solvent plasticizer for cellulose

acetate, other cellulose esters,

nitrocellulose, and ethyl cellulose

TRIBUTYL ACETYLCITRATE  
(Cont.)

Solubility (per 100 ml.):

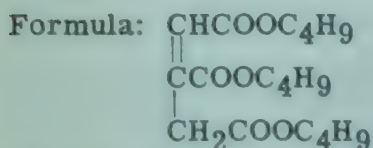
<0.002 grams (in water)  
100 cc. (in mineral oil)  
soluble in organic solvents

Additional Data:

evaporation rate (grams/sq.cm./hour  
at 105°C.), 0.000049  
hydrolysis (after boiling 6 hours in  
water and allowing to stand over  
night), <0.1%

TRIBUTYL ACONITATE

Synonyms: aconitic acid tributyl ester



Characteristics: very slight odor

Formula Weight: 342.4

Boiling Point: 190°C. (at 3 mm.)

Specific Gravity:  
1.108 at 20°C. 8.50 lbs. per gal.

Refractive Index: 1.4532 at 26°C.

Viscosity (Saybolt; 0.062" orifice):  
109 seconds

Uses:

solvent plasticizer for cellulose  
acetate, other cellulose esters, and  
ethers, ethyl cellulose, and nitro-  
cellulose  
organic syntheses

Solubility (per 100 ml.):

<0.002 grams (in water)  
100 ml. (in mineral oil)  
soluble in organic solvents

Additional Data:

evaporation rate (grams/sq.cm./hour  
at 105°C.), 0.000108  
hydrolysis (after boiling 6 hours in  
water and allowing to stand over  
night), 0.2%

TRIBUTYLAMINE

Synonyms: tri-n-butylamine

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2)_3\text{N}$

Characteristics:

deliquescent pale yellow

Formula Weight: 188.4

Melting Point: <-70°C.

Boiling Point:

214 to 216.5°C. (at 760 mm.)

Specific Gravity:

0.778(20/4) 6.5 lbs. per gal.  
0.7782(20/20)

Refractive Index: 1.431

Surface Tension (dynes per cm.):

24.9 at 20°C.

Viscosity (centipoises):

0.73 at 60°C. 1.35 at 25°C.

Flash Point: 185°F. (open)

Uses:

hydraulic fluid compositions

Solubility:

very slightly soluble in water  
soluble in methanol, acetone, benzene,  
gasoline, and ethyl acetate  
very soluble in alcohol and ether  
miscible with most organic solvents

Additional Data:

pH of 0.001 N aqueous solution at 25°C.  
(determined by hydrogen electrode):  
10.23  
coefficient of expansion,  
0.00105 per °C.

TRIBUTYL BORATE

Synonyms:

butyl borate n-butyl borate

Formula:  $\text{B}(\text{OC}_4\text{H}_9)_3$

Formula Weight: 230.2

Boiling Point:

200 to 235°C. (at 760 mm.)  
103 to 106°C. (at 8 mm.)

Specific Gravity: 0.858 to 0.859(20/20)



TRIBUTYL CITRATE (Cont.)

Additional Data:

evaporation rate (grams/sq. cm./hour at 105° C.), 0.000170  
hydrolysis (after boiling 6 hours in water and allowing to stand over night), 0.4%  
autoignition temperature, 695° F.

TRIBUTYL PHOSPHATE

Synonyms:

n-butyl phosphate  
tri-n-butyl phosphate

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{O})_3\text{PO}$

Formula Weight: 266.3

Melting Point: < -80° C.

Boiling Point:

289° C. (at 760 mm.)  
with decomposition  
177 to 178° C. (at 27 mm.)  
160 to 162° C. (at 15 mm.)

Specific Gravity:

0.9727(25/4)      0.976(25/25)  
8.13 lbs. per gal. at 68° F.

Refractive Index: 1.4226

Viscosity (Saybolt at 85° F.), 38 seconds

Flash Point: 295° F. (open)

Heat of Vaporization (gram-calories per g.): 55.1 at 289° C.

Uses:

plasticizer for cellulose acetate and nitrocellulose lacquers and plastics

Solubility (per cent by volume at 25° C.):

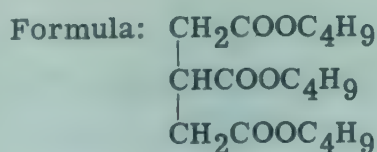
0.6 (in water)  
approximately 7 (water in tributyl phosphate)  
soluble in toluene and carbon disulfide  
∞ (in alcohol)      ∞ (in ether)

Additional Data: vapor density, 8.96

TRIBUTYL TRICARBALLYLATE

Synonyms:

tricarballic acid tributyl ester



Characteristics: very slight odor

Formula Weight: 344.4

Boiling Point: 305° C. (at 760 mm.)

Specific Gravity:

1.004 at 24° C.      8.38 lbs. per gal.

Refractive Index: 1.4388 at 26.5° C.

Viscosity (Saybolt; 0.062" orifice):

91 seconds

Uses:

solvent plasticizer for cellulose acetate and other cellulose esters and ethers, ethyl cellulose, and nitrocellulose

Solubility (per 100 ml.):

< 0.002 grams (in water)  
100 cc. (in mineral oil)  
soluble in organic solvents

Additional Data:

evaporation rate (grams/sq.cm./hour at 105° C.), 0.000262  
hydrolysis (after boiling 6 hours in water and allowing to stand over night), < 0.1%

TRIBUTYRIN

Synonyms:

butyrin  
glycerol tributyrate  
glyceryl tributyrate

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{COO})_3\text{C}_3\text{H}_5$

Characteristics: oily

Formula Weight: 302.4

Melting Point: < -75° C.

Boiling Point:

315° C. (at 760 mm.)  
287 to 288° C. (at 760 mm.)  
203 to 204° C. (at 25 mm.)

Specific Gravity: 1.032 to 1.0350(20/4)

Refractive Index: 1.4359

## Solubility:

insoluble in water  
very soluble in alcohol and ether

## TRICAPROIN

## Synonyms:

glycerol tricaproate  
glyceryl tricaproate

Formula:  $(C_5H_{11}COO)_3C_3H_5$

Formula Weight: 386.5

Melting Point:  $-25^{\circ}C$ .

Specific Gravity: 0.987(20/4)

## Solubility:

insoluble in water  
soluble in 85% alcohol and in ether

## TRICAPRYLIN

## Synonyms:

glycerol tricaprylate  
glyceryl tricaprylate

Formula:  $(C_7H_{15}COO)_3C_3H_5$

Formula Weight: 470.7

Melting Point:  $9^{\circ}C$ .

Specific Gravity: 0.954(20/4)

## Solubility:

insoluble in water  
soluble in 85% alcohol and in ether

## TRICHLOROACETYL CHLORIDE

Formula:  $CCl_3COCl$

Formula Weight: 181.9

Boiling Point:  $118^{\circ}C$ . (at 760 mm.)

Specific Gravity: 1.629 at  $16.2^{\circ}C$ .

## Solubility:

decomposed by water and alcohol  
 $\infty$  (in ether)

## 1,2,4-TRICHLOROBENZENE

## Synonyms:

as-trichlorobenzene  
as-trichlorobenzol

Formula:  $C_6H_3Cl_3$

## Characteristics:

characteristic chlorobenzene odor  
mobile

Formula Weight: 181.5

## Melting Point:

$17^{\circ}C$ .  
freezing point,  $10^{\circ}C$ .

## Boiling Point:

$213.0^{\circ}C$ . (at 760 mm.)  
 $205$  to  $235^{\circ}C$ . (at 760 mm.)

## Specific Gravity:

1.446 at  $26^{\circ}C$ .      1.465(15.5/15.5)  
1.574(10/4)

## Refractive Index:

1.5671      1.570

Flash Point:  $244^{\circ}F$ . (closed)

## Uses:

heat transfer medium  
insecticides  
solvent for fats, oils, resins, and  
waxes

## Solubility:

insoluble in water  
slightly soluble in alcohol  
very soluble in ether  
completely miscible with most organic  
solvents

## Additional Data:

chlorine content of technical product,  
45.9%  
fire point, none up to the boiling point

## TRICHLOROBENZENE

## Synonyms:

a commercial mixture of 1,2,3- and  
1,2,4-trichlorobenzene

Formula:  $C_6H_3Cl_3$

## Characteristics:

refractive  
odor similar to that of o-dichloro-  
benzene

Formula Weight: 181.5

## TRICHLOROBENZENE (Cont.)

Melting Point: 7.5 to 11° C.

Boiling Point:

214.8° C. (at 760 mm.)213 to 217° C. (at 760 mm.)205 to 250° C. (at 760 mm.)

Specific Gravity:

1.460(25/25)12.15 lbs. per gal. at 25° C.Refractive Index: 1.5700 at 25° C.Viscosity (centipoises): 1.97 at 25° C.Flash Point: 212° F. (closed)Specific Heat (gram-calories per g.  
per °C.)(liquid): 0.20Heat of Vaporization (gram-calories  
per g. at boiling point): 58.2  
Btu./lb., 105

Uses:

addition agent for some lubricating oils  
dielectric fluid            intermediates  
dyes                        organic syntheses  
solvent for oil-soluble dyes  
synthetic transformer oils

Solubility (grams per 100 g.):

280 (in alcohol)

insoluble in water

∞ (in ether, benzene, and carbon  
tetrachloride)miscible with most organic solvents  
and oils

Additional Data:

fire point, nonedielectric constant (1000 cycle), 4.93dielectric strength (0.1" gap),  
> 30,000 voltsspecific resistivity (ohms/cm.),  
2.9 x 10<sup>9</sup>

## 1,2,3-TRICHLOROBUTANE

Formula:  $\text{CH}_2\text{ClCHClCHClCH}_3$ 

Formula Weight: 161.5

Boiling Point:

169.0 to 169.3° C. (at 760 mm.)

Specific Gravity:

1.3017(20/4)10.86 lbs. per gal. at 20° C.

Additional Data:

coefficient of expansion,  
0.000518 per ° F. $\beta,\beta,\beta$ -TRICHLORO-tert-  
BUTYL ACETATE

Synonyms:

acetic acid  $\beta,\beta,\beta$ -trichloro-tert-  
butyl esterFormula:  $\text{CH}_3\text{COOC}(\text{CH}_3)_2\text{CCl}_3$ 

Formula Weight: 219.5

Boiling Point: 191° C.

Solubility:

insoluble in water

very soluble in alcohol, ether,  
chloroform, acetone, and benzene

## 2,2,3-TRICHLOROBUTYRALDEHYDE

Synonyms:

butyl chloral

butyrchloral

trichlorobutaldehyde

2,2,3-trichlorobutanal

 $\alpha,\alpha,\beta$ -trichlorobutyraldehydeFormula:  $\text{CH}_3\text{CHClCCl}_2\text{CHO}$ 

Characteristics: oily

Formula Weight: 175.5

Boiling Point: 164 to 165° C. (at 750 mm.)Specific Gravity: 1.3956(20/4)Refractive Index: 1.47554

Solubility:

soluble in water, alcohol, and ether

1,1,1-TRICHLORO-2,2-  
DIETHOXYETHANE

Synonyms:

chloral diethylacetal

trichloroacetal

Formula:  $\text{CCl}_3\text{CH}(\text{OC}_2\text{H}_5)_2$

Formula Weight: 221.5

Boiling Point: 197° C. (at 760 mm.)

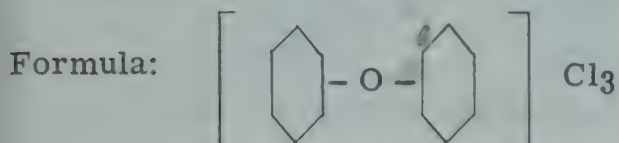
Specific Gravity: 1.266(15/4)

Solubility (grams per 100 ml.):

0.5 (in water)

∞ (in alcohol, ether, and glycerol)

#### x-TRICHLORODIPHENYL ETHER



#### Characteristics:

colorless to pale straw color

mild, characteristic odor

Formula Weight: 273.5

Freezing Point: < -20° C.

Boiling Point: 170 to 190° C. (at 8 mm.)

Specific Gravity: 1.38 to 1.40(25/25)

Viscosity (centipoises):

22.2 at 25° C. 5.6 at 60° C.

Flash Point: 327° F. (closed)

Solubility (grams per 100 ml.):

35 (in alcohol) insoluble in water

∞ (in ether, carbon tetrachloride, acetone, and benzene)

#### 1,1,1-TRICHLOROETHANE

Synonyms: methylchloroform

Formula: CH<sub>3</sub>CCl<sub>3</sub>

#### Characteristics:

mild chloroform-like odor

Formula Weight: 133.4

Melting Point: -30.6° C.

Boiling Point:

74.1° C. (at 760 mm.)

73 to 75° C. (at 760 mm.)

Specific Gravity:

1.332(25/25) 1.3249(26/4)

11.1 lbs. per gal. at 25° C.

#### Refractive Index:

1.43765 at 21.0° C. 1.435 at 25° C.

Viscosity (centipoises): 0.8 at 25° C.

#### Flash Point:

none (closed)

none (open)

#### Uses:

general solvent

grain fumigant

#### Solubility:

insoluble in water

∞ (in alcohol, ether, acetone, benzene, and carbon tetrachloride)

Additional Data: fire point, none

#### 1,1,2-TRICHLOROETHANE

#### Synonyms:

ethylene trichloride

β-trichloroethane

vinyl trichloride

Formula: CH<sub>2</sub>ClCHCl<sub>2</sub>

#### Characteristics:

volatile

sweet, characteristic odor

Formula Weight: 133.4

Melting Point: -36.7° C.

Boiling Point:

113.5 to 113.9° C. (at 760 mm.)

Specific Gravity:

1.441(25.5/4)

1.434(25/25)

1.443(20/4)

12.0 lbs. per gal. at 20° C.

#### Refractive Index:

1.4711

1.4683 at 25° C.

Viscosity (centipoises): 1.08 at 25° C.

#### Flash Point:

none (closed)

none (open)

Specific Heat (gram-calories per g.

per ° C.)(liquid): 0.27

Heat of Vaporization (gram-calories

per g. at boiling point): 60.6

123 Btu./lb.

## 1,1,2-TRICHLOROETHANE (Cont.)

## Uses:

cleaning fluid                      organic syntheses  
extractant  
solvent for fats, oils, resins, waxes,  
cellulose acetate, natural and some  
synthetic rubbers (e.g. Thiokol  
products)

## Solubility (per cent by weight):

0.05 at 20° C. (of water)  
insoluble in water  
∞ (in alcohol, ether, and benzene)  
soluble in most organic solvents

## Additional Data:

fire point, none  
specific resistivity (ohms/cm.),  
5.2 x 10<sup>8</sup>  
weight of pure vapor, 5950 mg./l.  
vapor density, 4.6

## 2,2,2-TRICHLOROETHANOL

Synonyms: trichloroethyl alcohol

Formula:  $\text{CCl}_3\text{CH}_2\text{OH}$

Formula Weight: 149.4

Melting Point: 17.8° C.

Boiling Point: 152.2° C. (at 760 mm.)

Specific Gravity: 1.550(23/4)

## Solubility:

slightly soluble in water  
∞ (in alcohol)                      ∞ (in ether)

 $\beta$ -TRICHLOROETHYL ACETATE

## Synonyms:

acetic acid trichloroethyl ester

Formula:  $\text{CH}_3\text{COOCH}_2\text{CCl}_3$

Characteristics: oily

Formula Weight: 191.5

Boiling Point: 170° C. (at 747 mm.)

Specific Gravity: 1.189 at 15° C.

## 1,1,2-TRICHLOROETHYLENE

## Synonyms:

chlorylene  
ethinyl trichloride  
ethylene trichloride  
"Tri"  
1,2,2-trichlorethylene

Formula:  $\text{CHCl:CCl}_2$

## Characteristics:

sweet, characteristic odor, somewhat  
like that of chloroform  
heavy                                      mobile

Formula Weight: 131.4

## Melting Point:

-88° C.                                      -73° C.  
-86° C.

Boiling Point: 86.7 to 87° C. (at 760 mm.)

## Specific Gravity:

1.466(20/20)	1.4996(0/4)
1.45560(25/4)	1.4762(15/4)
1.461(25/25)	1.4514(30/4)
1.462(20/4)	1.4262(45/4)
1.47(15/4)	1.3997(59.5/4)
<u>12.16 lbs. per gal. at 25° C.</u>	

## Refractive Index:

1.4777 at 19.8° C.	1.4749 at 25° C.
1.479141 at 17° C.	<u>1.4735</u> at 27° C.
1.4782 at 20° C.	

## Surface Tension (dynes per cm.):

<u>32.0</u> at 25° C.	29 at 30° C.
-----------------------	--------------

## Viscosity (centipoises):

0.58 at 20° C.	0.446 at 50° C.
0.550 at 25° C.	0.371 at 75° C.

## Flash Point:

none (closed)                              none (open)

Specific Heat (gram-calories per g.  
per ° C.)(liquid): 0.22

Heat of Vaporization (gram-calories  
per g.):

57.2 at the boiling point  
(Btu./lb.), 103.0 at the boiling point

## Uses:

degreasing and dry cleaning  
 extraction of edible products  
 metal degreasing      pharmaceuticals  
 dyes                      perfumes  
 insecticides              leather  
 organic syntheses      rubber  
 paints                      varnishes  
 bone degreasing for bone glue  
 vermin extermination  
 paint and varnish removers  
 solvent for bitumens, chewing gum,  
 chlorinated hydrocarbons, crude  
 rubber, dyes, fats, grease, gums,  
 oils, pitch, resin, and waxes

## Solubility (grams per 100 grams of solution):

0.11 at 25 (in water)  
 0.017 at 10, 0.025 at 18, 0.035 at 28  
 (water in 1,1,2-trichloroethylene)  
 $\infty$  (in alcohol)       $\infty$  (in ether)  
 miscible with most organic solvents

## Additional Data:

fire point, none  
 dielectric constant (1000 cycle),  
     3.274                      3.42  
 power factor (1000 cycle), 2.2%  
 specific resistivity (ohms/cm.),  
      $6.6 \times 10^9$   
 azeotrope with water, boiling point,  
      $71.85^\circ\text{C.}$ , 93.2%  
     1,1,2-trichloroethylene  
 coefficient of expansion,  
     0.000663 per  $^\circ\text{F.}$ , 0.00117 per  $^\circ\text{C.}$   
 weight of pure vapor, 5860 mg./l.  
 vapor density, 4.5  
     0.277 lbs./cu.ft. at  $90^\circ\text{C.}$   
     3.6 cu. ft./lb. at  $90^\circ\text{C.}$   
 heat conductivity (liquid)  
     per sq/ft./ $^\circ\text{F.}$ /hour,  
     0.0672 to 0.0718 Btu.  
 steam distillation point (1 atm.),  $73^\circ\text{C.}$   
     solvent: water ratio (by weight): 13.4:1  
 critical temperature,  $271^\circ\text{C.}$   
 critical pressure, 495 atm.  
 thermal conductivity of liquid  
     at  $20^\circ\text{C.}$ , 0.0801  
 diffusivity in air (sq.cm./sec.  
      $25^\circ\text{C.}$ , 1 atm.), 0.073  
 evaporation rate (ether = 100), 28

## 1,1,2-TRICHLORO-2-FLUOROETHANE

Formula:  $\text{CHCl}_2\text{CHClF}$ 

Formula Weight: 151.4

Boiling Point:  $103^\circ\text{C.}$  (at 760 mm.)Specific Gravity: 1.550 at  $17^\circ\text{C.}$ 

Solubility:

insoluble in water       $\infty$  (in alcohol)  
     $\infty$  (in ether)

## 1,1,2-TRICHLORO-2-FLUOROETHYLENE

Formula:  $\text{CClF:CCl}_2$ 

Formula Weight: 149.4

Melting Point:  $-82^\circ\text{C.}$ Boiling Point:  $71^\circ\text{C.}$  (at 760 mm.)Specific Gravity: 1.530 at  $25^\circ\text{C.}$ 

Solubility: decomposed by water

## TRICHLOROFLUOROMETHANE

Synonyms:

F-11  
 fluorotrichloromethane

Formula:  $\text{CCl}_3\text{F}$ 

Formula Weight: 137.4

Melting Point:  $-111^\circ\text{C.}$ 

Boiling Point:

23.7 to  $24.1^\circ\text{C.}$  (at 760 mm.)Specific Gravity: 1.494 at  $17.2^\circ\text{C.}$ 

Uses: refrigerant

Solubility:

insoluble in water  
 very soluble in alcohol and ether

Additional Data:

critical temperature,  $198.0^\circ\text{C.}$   
 critical pressure, 43.2 atm.

## TRICHLOROIODOMETHANE

Formula:  $\text{CCl}_3\text{I}$ 

Formula Weight: 245.3

## TRICHLOROIODOMETHANE (Cont.)

Melting Point:  $-19^{\circ}\text{C}$ .

Boiling Point:

 $42^{\circ}\text{C}$ . (at 760 mm.) with decompositionSpecific Gravity: 2.36 at  $17^{\circ}\text{C}$ .

## TRICHLOROMETHANETHIOL

Synonyms:

Clairsite

perchloromethyl mercaptan

Formula:  $\text{CCl}_3\text{SCI}$ 

Characteristics:

oily

unpleasant odor

yellow

Formula Weight: 185.9

Boiling Point:

 $148$  to  $149^{\circ}\text{C}$ . (at 760 mm.)

with slight decomposition

Specific Gravity:

 $1.772$  at  $0^{\circ}\text{C}$ . $1.695$  at  $17.5^{\circ}\text{C}$ .

Uses:

granary fumigant      organic syntheses

Additional Data:

vapor density,  $6.6414$ volatility (mg./cu. m. at  $20^{\circ}\text{C}$ .),  $18,000$ 

## TRICHLOROPHENYLSILICANE

Synonyms: siliconphenyl trichloride

Formula:  $\text{C}_6\text{H}_5\text{SiCl}_3$ 

Formula Weight: 211.5

Boiling Point:

 $197$  to  $201.0^{\circ}\text{C}$ . (at 760 mm.)

Solubility:

decomposed by water and alcohol  
soluble in ether and chloroform

## 1,1,2-TRICHLOROPROPANE

Formula:  $\text{CH}_3\text{CHClCHCl}_2$ 

Characteristics: oily

Formula Weight: 147.4

Melting Point:  $< -20^{\circ}\text{C}$ .Boiling Point:  $140^{\circ}\text{C}$ . (at 760 mm.)Specific Gravity: 1.372 at  $25^{\circ}\text{C}$ .

Solubility:

insoluble in water       $\infty$  (in alcohol) $\infty$  (in ether)

## 1,2,3-TRICHLOROPROPANE

Synonyms:

allyl trichloride

glycerol trichlorohydrin

glyceryl trichlorohydrin

trichlorohydrin

Formula:  $\text{CH}_2\text{ClCHClCH}_2\text{Cl}$ 

Formula Weight: 147.4

Melting Point:  $-18$  to  $-14.7^{\circ}\text{C}$ .Boiling Point:  $156$  to  $158^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

 $1.417(15/4)$  $1.391(20/4)$  $11.59$  lbs. per gal. at  $20^{\circ}\text{C}$ .Flash Point:  $174^{\circ}\text{F}$ . (open)Heat of Vaporization (gram-calories  
per g.): 62.4

Uses:

solvent for some coumarone and  
phenolic resins, chlorinated rubber,  
and ethyl cellulose

Solubility (grams per 100 ml.):

 $0.1$  at  $20^{\circ}\text{C}$ . (of water) $< 0.1$  (in water)

very soluble in alcohol and ether

Additional Data:

coefficient of expansion,  
 $0.000534$  per  $^{\circ}\text{F}$ . $\alpha$ -TRICHLOROTOLUENE

Synonyms:

benzenyl trichloride

benzoic trichloride

benzotrichloride

phenylchloroform

toluene trichloride

Formula:  $\text{C}_6\text{H}_5\text{CCl}_3$

## Characteristics:

colorless to light green or yellow  
oily

Formula Weight: 195.5

Freezing Point: -22 to -21.2°C.

## Boiling Point:

220.7°C. (at 760 mm.)

213 to 214°C. (at 760 mm.)

218 to 223°C. (at 760 mm.)

Specific Gravity: 1.380 at 14°C.

## Uses:

intermediate in dye syntheses

## Solubility:

insoluble in and decomposed by water  
soluble in alcohol, ether, and benzene

## Additional Data:

irritates the skin

vapors irritate the eyes

avoid breathing of vapors and contact  
with the skin

1,1,2-TRICHLORO-1,2,2-  
TRIFLUOROETHANE

Formula:  $\text{Cl}_2\text{CFCClF}_2$

Formula Weight: 187.4

Melting Point: -37 to -35°C.

## Boiling Point:

47.6°C. (at 760 mm.)

46.5°C. (at 740 mm.)

Specific Gravity: 1.42 at 25°C.

## Solubility:

insoluble in water

∞ (in alcohol, ether, and benzene)

## Additional Data:

critical temperature, 214.1°C.

critical pressure, 33.7 atm.

## TRIDECANE

Formula:  $\text{CH}_3(\text{CH}_2)_{11}\text{CH}_3$

Formula Weight: 184.4

Melting Point: -6.2°C.

Boiling Point: 234°C. (at 760 mm.)

## Specific Gravity:

0.757(20/4)

0.761

Refractive Index: 1.4419 at 16.8°C.

Uses: organic syntheses

## Solubility:

insoluble in water

very soluble in alcohol and ether

## TRIDECANENITRILE

## Synonyms:

1-cyanododecane

dodecyl nitrile

dodecyl cyanide

lauryl nitrile

Formula:  $\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{CN}$

Formula Weight: 195.3

Boiling Point: 275°C. (at 760 mm.)

## Solubility:

very soluble in alcohol and ether

## TRIDECENE

Synonyms: tridecylene

Formula:  $\text{C}_{13}\text{H}_{26}$

Formula Weight: 182.3

Boiling Point: 232.7°C. (at 760 mm.)

## Specific Gravity:

0.7977(20/4)

0.845 at 0°C.

## Solubility:

insoluble in water

soluble in alcohol

very soluble in ether

## TRIETHANOLAMINE

Synonyms: tri-2-hydroxyethylamine

Formula:  $\text{N}(\text{CH}_2\text{CH}_2\text{OH})_3$

## Characteristics:

viscous

ammoniacal odor

hygroscopic

pale yellow

Formula Weight: 149.2

## Melting Point:

20 to 21°C.

21.2°C.

## TRIETHANOLAMINE (Cont.)

## Boiling Point:

360° C. (at 760 mm.)

277 to 279° C. (at 150 mm.)

244° C. (at 50 mm.)

208° C. (at 10 mm.)

## Specific Gravity:

1.1242(20/4)

1.1258(20/20)

9.4 lbs. per gal. at 20° C.

## Refractive Index: 1.4852

## Vapor Pressure (mm. Hg):

&lt;0.01 at 20° C.

Viscosity (centipoises): 10 at 20° C.

## Flash Point:

355° F. (closed)365° F. (open)Heat of Vaporization (Btu./lb.): 230

## Uses:

adhesives	resins
cosmetics	rubber dispersing
dry cleaning	leather stuffing
inks	wood penetration
paper and textile softening	
fatty acid soaps	
solvent and plasticizer for cellulose	
acetate, glues, lacquers, nitro-	
cellulose, and some textiles	

## Solubility:

∞ (in water)                      ∞ (in alcohol)  
 slightly soluble in ether  
 soluble in chloroform

## Additional Data:

pH of 25% solution at 25° C., 11.2vapor density, 5.14

## TRIETHYL ACETYLCITRATE

## Synonyms:

acetylcitric acid triethyl ester

## Formula:

 $\text{CH}_3\text{COO}(\text{CCOOC}_2\text{H}_5)(\text{CH}_2\text{COOC}_2\text{H}_5)_2$ 

## Formula Weight: 318.1

## Specific Gravity:

1.135 at 23° C.9.47 lbs. per gal.Refractive Index: 1.4386 at 23° C.Viscosity (Saybolt; 0.062" orifice):  
230 seconds

## Uses:

solvent plasticizer for cellulose  
 acetate and other cellulose esters and  
 ethers, ethyl cellulose, and nitro-  
 cellulose  
 plasticizer for lacquers

## Solubility (per 100 ml.):

0.72 grams (in water)

1.2 cc. (in mineral oil)

soluble in organic solvents

## Additional Data:

evaporation rate at 105° C.

(gram/sq.cm./hour), 0.000497

hydrolysis (after boiling 6 hours in  
 water and allowing to stand over  
 night), <0.1%

## TRIETHYL ACONITATE

## Synonyms:

aconitic acid triethyl ester

Formula:  $\text{CHCOOC}_2\text{H}_5$  $\text{CCOOC}_2\text{H}_5$  $\text{CH}_2\text{COOC}_2\text{H}_5$ 

## Characteristics: slightly colored

## Formula Weight: 258.3

Boiling Point: 155° C. (at 5 mm.)

## Specific Gravity:

1.0957 at 24.5° C.    9.14 lbs. per gal.Refractive Index: 1.4517 at 26° C.Viscosity (Saybolt; 0.062" orifice):  
76 seconds

## Uses:

antioxidant for oils etc.  
 negative catalyst to prevent  
 polymerization  
 solvent plasticizer for cellulose  
 acetate and other cellulose esters  
 and ethers, ethyl cellulose, and  
 nitrocellulose

## Solubility (grams per 100 ml.):

0.18 (in water)

8 (in mineral oil)

soluble in common organic solvents

## Additional Data:

evaporation rate at 105° C.

(gram/sq.cm./hour), 0.001491hydrolysis (after boiling 6 hours in water and allowing to stand over night), 0.24%

## TRIETHYLAMINE

Formula:  $(C_2H_5)_3N$ 

Characteristics: oily

Formula Weight: 101.2

Melting Point: -114.8° C.

Boiling Point:

89.5° C. (at 760 mm.)

85 to 91° C. (at 760 mm.)

72 to 95° C. (at 760 mm.)

Specific Gravity:

0.729(20/20)      0.74 to 0.76(20/20)0.728(20/4)      6.07 lbs. per gal.

0.7229(25/4)

Refractive Index: 1.40032

Flash Point: 200° F. (open)

Heat of Combustion (calories per gram):

10248

Uses:

petroleum cracking

quaternary ammonium penetrating,

waterproofing, and wetting agents

for textile processing

accelerator activators for natural and synthetic rubbers

emulsifying agents and germicides

stabilizer for some halogenated hydrocarbons

catalytic solvent for some syntheses

solvent for many organic compounds

Solubility (grams per 100 ml.):

1.5 at 20° C., 1.97 at 65° C. (in water)

soluble in methanol, acetone, benzene,

gasoline, and ethyl acetate

∞ (in alcohol)      ∞ (in ether)

Additional Data:

heat of solution in water at infinite

solute: 10,040 cal./mol. of solute

dissociation constant at 25° C.,

 $6.4 \times 10^{-4}$ 

pH of aqueous solution at 25° C.

(determined by hydrogen electrode)

Normality of Solution	pH
0.1	11.75
0.05	11.68
0.01	11.26
0.001	10.25

## TRIETHYLARSINE

Synonyms:

arsenic triethyl      triethylarsenic

Formula:  $As(C_2H_5)_3$ 

Formula Weight: 162.1

Boiling Point:

141° C. (at 760 mm.)

with decomposition

Specific Gravity: 1.150(20/4)

Refractive Index: 1.467

Solubility:

insoluble in water

very soluble in alcohol and ether

## 1,2,4-TRIETHYLBENZENE

Synonyms: as-triethylbenzeneFormula:  $(C_2H_5)_3C_6H_3$ 

Characteristics: aromatic odor

Formula Weight: 162.3

Boiling Point: 217 to 218° C. (at 760 mm.)

Specific Gravity: 0.8819(17/4)

Refractive Index: 1.4972

Flash Point: 181° F. (closed)

Solubility:

insoluble in water

soluble in alcohol and ether

## 1,3,5-TRIETHYLBENZENE

Synonyms: sym-triethylbenzeneFormula:  $(C_2H_5)_3C_6H_3$ 

Formula Weight: 162.3

Boiling Point: 215 to 218° C. (at 760 mm.)

## 1,3,5-TRIETHYLBENZENE (Cont.)

Specific Gravity: 0.863(20/4)

Refractive Index: 1.4939

Solubility:

insoluble in water

very soluble in alcohol and ether

x-TRIETHYLBENZENE

Synonyms:

Alkazene 3 - a commercial mixture  
of isomersFormula:  $(C_2H_5)_3C_6H_3$ 

Characteristics:

mild, characteristic odor

Formula Weight: 162.3

Melting Point: <-70° C.

Boiling Point:

217.6 to 219.3° C. (at 760 mm.)Specific Gravity: 0.870(25/25)

Viscosity (centipoises):

1.3 at 25° C.0.8 at 60° C.

Solubility (grams per 100 ml.):

120 (in methanol) insoluble in water  
∞ (in ether and carbon tetrachloride)

## TRIETHYL CITRATE

Synonyms:

citric acid triethyl ester  
ethyl citrateFormula:  $C_3H_5O(COOC_2H_5)_3$ 

Characteristics:

oily mobile  
bitter grapefruit taste  
very slight odor

Formula Weight: 276.3

Boiling Point:

294° C. (at 760 mm.)176° C. (at 12 mm.)150° C. (at 3 mm.)

Specific Gravity:

1.137(20/4)

1.146

1.136 at 20° C.9.48 lbs. per gal.

Refractive Index: 1.4405 at 24.5° C.

Viscosity (Saybolt; 0.062" orifice):

160 seconds

Uses:

agglutinant paint removers  
plasticizer for cellulose acetate and  
cellulose nitrate  
softener  
solvent for cellulose acetals, nitrate  
and ether, resins, starches etc.  
fixative in flavoring essences

Solubility (grams per 100 ml.):

6.5 (in water) ∞ (in alcohol)

0.8 (in mixed oil) ∞ (in ether)

soluble in organic solvents

Additional Data:

evaporation rate at 105° C.

(grams/sq.cm./hour), 0.00076hydrolysis (after boiling 6 hours in  
water and allowing to stand over  
night), 0.4%

## TRIETHYLENE GLYCOL

Synonyms:

2,2'-ethylenedioxydiethanol  
glycol bis(hydroxyethyl)ether  
triglycolFormula:  $(CH_2OCH_2CH_2OH)_2$ 

Characteristics:

nearly odorless hygroscopic

Formula Weight: 150.2

Melting Point: -5° C.

Boiling Point:

280 to 290° C. (at 760 mm.)278.3° C. (at 760 mm.)287.4° C. (at 760 mm.)285° C. (at 760 mm.)387° F. (at 50 mm.)

Specific Gravity:

1.125(20/20)1.122(77/77)° F.9.4 lbs. per gal. at 20° C.Refractive Index: 1.454

Surface Tension (dynes per cm.):

45 at 77° F.

Vapor Pressure (mm. Hg):  
    <0.01 at 20° C.

Viscosity (centipoises):  
    155 at 32° F.                      4 at 150° F.  
    34 at 77° F.

Flash Point:  
    350° F. (closed)              385° F. (open)

Specific Heat (gram-calories per g.  
per ° C.)(liquid): 0.54 at 77° F.

Uses:  
    high boiling solvent  
    plasticizer for cork adhesives  
    atmospheric sterilization  
    lacquers                      organic syntheses  
    solvent for gums, nitrocellulose resins  
    heat transfer medium for heating  
        cabins of large military aircraft  
    moisture control agent in foundry sand  
    for magnesium castings

Solubility:  
    ∞ (in water, alcohol, and benzene)  
    slightly soluble in ether  
    insoluble in petroleum  
    immiscible with toluene and gasoline

Additional Data:  
    vapor density, 5.17  
    pour point, -70° F.  
    fire point (A.S.T.M., open cup, 345° F.

TRIETHYLENE GLYCOL  
bis(*d*-ETHYLCAPROATE)

Synonyms:  
    "Flexol" plasticizer 3GO  
    triethylene glycol di 2-ethylhexoate  
    triglycol dioctoate

Formula:  
C7H15COOCH2(CH2OCH2)2CH2OCOC7H15

Characteristics: mild odor

Formula Weight: 402.6

Melting Point: very viscous at -55° C.

Boiling Point:  
    370° C. (at 760 mm.)  
    215° C. (at 5 mm.)

Specific Gravity:  
    0.9679(20/20)  
    8.06 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg):  
    <0.01 at 20° C.              0.22 at 150° C.

Viscosity (centipoises): 16.1 at 20° C.

Flash Point: 405° F. (open)

Uses:  
    adhesives for coated cloth  
    plasticizer  
    sealants for industrial purposes

Solubility (per cent at 20° C.):  
    0.4 (of water)                      <0.01 (in water)  
    miscible with mineral oil

Specific Heat of Triethylene Glycol Solutions

Temp. ° C.	% Triethylene Glycol by Weight						
	100	80	60	40	20	10	5
10	0.533	0.669	0.752	0.822	0.862	0.883	0.899
20	0.539	0.679	0.760	0.826	0.868	0.886	0.899
30	0.546	0.689	0.762	0.830	0.872	0.888	0.900
40	0.553	0.698	0.775	0.835	0.875	0.889	0.900
50	0.563	0.709	0.784	0.840	0.878	0.890	0.901
60	0.575	0.720	0.792	0.844	0.882	0.892	0.902
70	0.588	0.729	0.799	0.847	0.884	0.893	0.902
80	0.600	0.737	0.803	0.849	0.885	0.893	0.902
90	0.610	0.744	0.807	0.850	0.885	0.893	0.902

TRIETHYLENE GLYCOL  
bis(*d*-ETHYLCAPROATE) (Cont.)

## Additional Data:

volatility (mg./sq.cm./hour),  
0.18 at 100° C.      50 at 190° C.  
 heat stability, good  
 nitrocellulose dilution ratio, 0.63  
 good resistance to ultraviolet light  
 D.C. resistivity at 25° C.,  
 $1.6 \times 10^3$  megohm-cm.

Compatability of Triethylene Glycol bis(*d*-Ethylcaproate)  
with Various Resins\*

Resin	Ratio of Resin to Plasticizer		
	1:1	4:1	9:1
Vinyl acetate resins	I-L	I-L	C
Vinyl butyral resins	C-L	C-L	C
Vinyl chloride resins	-	C	C
Vinyl chloride-acetate resins	C	C	C
Vinylidene chloride resins (coating type)	I	I	S-I
Cellulose acetate	I	I	I
Cellulose acetobutyrate	I-W	SI-W	C
Cellulose nitrate	C	C	C
Ethyl cellulose	C-W	C	C

C = compatible

I = incompatible

W = weak film

S = slightly

L = plasticizer sweats out

\* Carbon and Carbide Chemicals Corporation data sheet.

TRIETHYLENE GLYCOL  
bis(*d*-ETHYLBUTYRATE)

## Synonyms:

"Flexol" plasticizer 3GH  
 triethylene glycol di-2-ethylbutyrate  
 triglycol dicaproate  
 triglycol dihexoate

## Formula:

$$C_5H_{11}COOCH_2(CH_2OCH_2)_2CH_2OCOC_5H_{11}$$

Formula Weight: 346.5

Melting Point: very viscous at -55° C.

## Boiling Point:

358.0° C. (at 760 mm.)202° C. (at 5 mm.)

## Specific Gravity:

0.9946(20/20)8.3 lbs. per gal. at 20° C.

Refractive Index: 1.4404

Viscosity (centipoises): 10.3 at 20° C.Flash Point: 385° F. (open)Heat of Vaporization (gram-calories  
per g.): 57.6103.6 Btu./lb.

## Uses:

printing inks for moistureproof  
 cellophane

plasticizer for vinyl butyral resin for  
 plastic interlayer in high-test safety  
 glass

Solubility (per cent at 20° C.):  
1.0 (of water)            0.2 (in mineral oil)  
0.02 (in water)

Additional Data:  
volatility (mg./sq.cm./hour),  
    0.86 at 100° C.,    63 at 190° C.  
coefficient of expansion,  
    0.00084 at 20° C.   0.00086 at 55° C.  
less volatile than dibutyl phthalate  
D.C. resistivity at 25° C.,  
    1 x 10<sup>5</sup> megohm-cm.  
nitrocellulose dilution ratio, 1.11

Compatibility of Triethylene Glycol bis(*α*-Ethylbutyrate)  
with Various Resins\*

Resin	Ratio of Resin to Plasticizer		
	1:1	4:1	9:1
Vinyl acetate resins	C	C	C
Vinyl butyral resin	C	C	C
Vinyl chloride-acetate resins	C	C	C
Vinylidene chloride resins (coating type)	I	I	S-I
Cellulose acetate	I	I	I
Cellulose acetobutyrate	I-W	C-L-W	C
Cellulose nitrate	C	C	C
Ethyl cellulose	C-W	C	C

C = compatible  
I = incompatible  
W = weak film  
S = slightly  
L = plasticizer sweats out

\* Carbide and Carbon Chemicals Corporation data sheet.

TRIETHYLENE GLYCOL DIACETATE

Formula: (CH<sub>3</sub>COOCH<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>)<sub>2</sub>

Formula Weight: 234.2

Boiling Point: 300° C. (at 760 mm.)

Solubility:  
∞ (in water, alcohol, and ether)

TRIETHYLENETETRAMINE

Synonyms:  
N,N'-bis(2-aminoethyl)ethylenediamine

Formula: (NH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NHCH<sub>2</sub>)<sub>2</sub>

Characteristics:  
viscous                    yellow

Formula Weight: 146.2

Melting Point: 12° C.

Boiling Point:  
266 to 267° C. (at 760 mm.)  
277.5° C. (at 760 mm.)

Specific Gravity:  
0.982 at 15° C.    0.9818(20/20)  
8.2 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg): <0.01 at 20° C.

Flash Point: 260° F. (open)

Uses:  
alkaline gas dehydration and  
purification

## TRIETHYLENETETRAMINE (Cont.)

solvent for acid gases, dyes, resins,  
and sulfur

detergents                      rubber  
softeners                      accelerators

Solubility:  
very soluble in water and alcohol

## Additional Data:

hygroscopic                      alkaline  
pH of 25% aqueous solution at 25°C.,  
12.4

## TRIETHYL ORTHOPROPIONATE

Synonyms: ethyl orthopropionate

Formula:  $C_2H_5C(OC_2H_5)_3$

Formula Weight: 176.3

Boiling Point: 161°C. (at 766 mm.)

Specific Gravity: 0.887 at 20°C.

## TRIETHYLPHOSPHINE

Formula:  $(C_2H_5)_3P$

Formula Weight: 118.2

Boiling Point: 127.5°C. (at 744 mm.)

Specific Gravity: 0.800(15/4)

Solubility:  
insoluble in water    ∞ (in alcohol)  
                                 ∞ (in ether)

## TRIETHYLSILICANE

Synonyms: triethyl silicon hydride

Formula:  $(C_2H_5)_3SiH$

Formula Weight: 116.3

Boiling Point: 95 to 96°C. (at 760 mm.)

Specific Gravity: 0.721(15/4)

Solubility:  
insoluble in water and sulfuric acid

## TRIETHYLSILICOL

Formula:  $(C_2H_5)_3SiOH$

Formula Weight: 132.3

Boiling Point: 154°C. (at 760 mm.)

Specific Gravity: 0.871 at 0°C.

Solubility: insoluble in water

## TRIETHYLSTIBINE

## Synonyms:

antimony triethyl    triethylantimony

Formula:  $Sb(C_2H_5)_3$

Formula Weight: 208.9

Melting Point: < -29°C.

Boiling Point: 159.5°C. (at 760 mm.)

Specific Gravity: 1.324 at 16°C.

Solubility:  
insoluble in water  
soluble in alcohol and ether

## TRIETHYLTIN

## Synonyms:

hexaethylditin    tin triethyl

Formula:  $[(C_2H_5)_3Sn]_2$

Formula Weight: 411.8

Boiling Point:  
265 to 270°C. (at 760 mm.)  
270°C. (at 760 mm.)  
with decomposition

Specific Gravity:  
1.4115(0/4)    1.412 at 0°C.

Solubility:  
insoluble in water and aqueous alcohol  
soluble in ether and benzene

## TRIETHYL TRICARBALLYLATE

## Synonyms:

tricarballylic acid triethyl ester

## Formula:

$C_2H_5OOCCH(CH_2COOC_2H_5)_2$

Characteristics: very slight odor

Formula Weight: 260.3

Boiling Point: 160°C. (at 5 mm.)

Specific Gravity:  
1.087 at 20° C.      9.08 lbs. per gal.

Refractive Index: 1.4324 at 26° C.

Viscosity (Saybolt; 0.062" orifice):  
71 seconds

Uses:  
 solvent plasticizer for cellulose  
 acetate and other cellulose esters  
 and ethers and other types of plastics  
 plasticizer for molded plastics

Solubility (grams per 100 ml.):  
0.62 (in water)      4.5 (in mineral oil)  
 soluble in many organic solvents

Additional Data:  
 evaporation rate at 105° C.  
 (grams/sq.cm./hour), 0.001444  
 hydrolysis (after boiling 6 hours in  
 water and allowing to stand over  
 night), 0.31%

#### $\alpha$ -TRIFLUOROTOLUENE

Synonyms:  
 benzotrifluoride      phenylfluoroform

Formula:  $C_6H_5CF_3$

Characteristics: aromatic odor

Formula Weight: 146.1

Melting Point: -29.05 to -29.3° C.

Boiling Point: 102.4° C. (at 760 mm.)

Specific Gravity:  
1.196 at 14° C.      1.197(15.5/15.5)  
9.9 lbs. per gal. at 15.5° C.

Refractive Index:  
1.41707 at 14° C.      1.4145 at 20° C.

Surface Tension (dynes per cm.):  
22.6 at 25° C.

Viscosity (centipoises):  
0.488 at 100° F.      0.282 at 210° F.  
 (centistokes):  
0.418 at 100° F.      0.260 at 210° F.

Flash Point: 53.6° F. (closed)

Specific Heat (gram-calories per g.  
 per ° C.)(liquid): 0.35 at 25° C.

Heat of Vaporization (gram-calories  
 per g.): 56 at the boiling point

Heat of Combustion (kilogram-calories.  
 per mole): 553 at constant volume

Uses:  
 dielectrics      organic syntheses  
 dyes      pharmaceuticals  
 insecticides

Solubility (grams per 100 grams at room  
 temperature):  
0.045 (in water)  
 $\infty$  (in alcohol and ether)  
 miscible with most common organic  
 solvents

Additional Data:  
 coefficient of expansion per ° C.  
 at 15.5° C., 0.0011  
 specific conductivity (ohm/cm)<sup>-1</sup>  
 at 25° C., 1 x 10<sup>-7</sup>  
 relative volatility at 25° C.,  
 (hexone = 1), 2.6  
 parachor, 270.2

#### TRIEPTYLTIN

Synonyms:  
 glycerol triheptylate  
 glyceryl triheptylate

Formula:  $(C_6H_{13}COO)_3C_3H_5$

Formula Weight: 482.6

Boiling Point: 233 to 235° C. (at 3 mm.)

Specific Gravity: 0.969 at 20° C.

Solubility:  
 insoluble in water      soluble in alcohol  
    soluble in ether

#### TRIHEXYLAMINE

Formula:  $(C_6H_{13})_3N$

Formula Weight: 269.5

Boiling Point: 260° C. (at 760 mm.)

Solubility:  
 very slightly soluble in water  
 very soluble in alcohol and ether

## TRIISOAMYLAMINE

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2]_3\text{N}$ 

Formula Weight: 227.4

Boiling Point:

237° C. (at 760 mm.)

242 to 245° C. (at 760 mm.)

265 to 267° C. (at 760 mm.)

Specific Gravity: 0.786(20/4)

Solubility:

insoluble in water  $\infty$  (in ether)

very soluble in alcohol

## TRISOBUTYLAMINE

Formula:  $[(\text{CH}_3)_2\text{CHCH}_2]_3\text{N}$ 

Formula Weight: 185.3

Melting Point: -22° C.

Boiling Point:

179.0° C. (at 760 mm.)

188 to 191° C. (at 760 mm.)

Specific Gravity:

0.766(25/25) 0.764(25/4)

Refractive Index: 1.42519 at 17.3° C.

Solubility:

insoluble in water  $\infty$  (in ether)

soluble in alcohol

x-TRIISOPROPYLBENZENE

Synonyms:

Alkazene 13

this is a mixture of isomers

Formula:  $\text{C}_6\text{H}_3[\text{CH}(\text{CH}_3)_2]_3$ 

Characteristics: nearly odorless

Formula Weight: 204.3

Freezing Point: -15° C.

Boiling Point:

235.9 to 237.4° C. (at 760 mm.)

230 to 240° C. (at 760 mm.)

Specific Gravity: 0.854(25/25)

Refractive Index: 1.488 at 25° C.

Viscosity (centipoises):

3.4 at 25° C. 2.0 at 60° C.

Flash Point: 206° F. (closed)

Solubility (grams per 100 ml.):

 $\frac{43}{\infty}$  (in methanol) insoluble in water $\infty$  (in ether and carbon tetrachloride)

## TRISOVALERIN

Synonyms:

glycerol triisovalerate

glyceryl triisovalerate

Formula:  $(\text{C}_4\text{H}_9\text{COO})_3\text{C}_3\text{H}_5$ 

Characteristics: oily

Formula Weight: 344.4

Boiling Point: 153 to 156° C. (at 2 mm.)

Specific Gravity: 0.998 at 20° C.

## 2,4,6-TRIMETHYLACETOPHENONE

Synonyms: acetomesitylene

Formula:  $(\text{CH}_3)_3\text{C}_6\text{H}_2\text{COCH}_3$ 

Formula Weight: 162.2

Boiling Point: 240.5° C. (at 735 mm.)

Specific Gravity: 0.975(20/4)

## TRIMETHYLANTIMONY

Synonyms:

antimony trimethyl trimethylstibine

Formula:  $\text{Sb}(\text{CH}_3)_3$ 

Formula Weight: 166.9

Boiling Point: 80.6° C. (at 760 mm.)

Specific Gravity: 1.523 at 15° C.

Solubility:

slightly soluble in water

insoluble in alcohol soluble in ether

## TRIMETHYLARSENIC

Synonyms:

arsenic trimethyl trimethylarsine

Formula:  $\text{As}(\text{CH}_3)_3$ 

Formula Weight: 120.0

Boiling Point: 52.8° C. (at 760 mm.)

Specific Gravity: 1.124(22/4)

Solubility:

slightly soluble in water  
soluble in alcohol  $\infty$  (in ether)

### TRIMETHYL BORATE

Synonyms:

methyl borate trimethylboron

Formula:  $(\text{CH}_3\text{O})_3\text{B}$

Formula Weight: 103.9

Boiling Point:

65°C. (at 760 mm.)

72°C. (at 760 mm.)

Specific Gravity: 0.915 at 20°C.

Solubility:

decomposed by water  
 $\infty$  (in alcohol)  $\infty$  (in ether)

### 2,2,3-TRIMETHYLBUTANE

Synonyms:

heptane  
isopropyltrimethylmethane

Formula:  $(\text{CH}_3)_3\text{CCH}(\text{CH}_3)_2$

Formula Weight: 100.2

Melting Point: -25.0°C.

Boiling Point: 80.8°C. (at 760 mm.)

Specific Gravity:

0.690(20/4)

in vacuo 0.69002(20/4)°C.,

0.69445(60/60)°F.

5.7897 lbs. per gal. at 60°F.

Refractive Index:

1.38946

1.38954

1.390

Specific Heat (Btu./lb./°F.)(liquid)

at 69.6°F.: 0.497

Heat of Vaporization (Btu./lb.):

124.6 at boiling point

137.46 at 77°F.

Uses: organic syntheses

Solubility:

insoluble in water soluble in alcohol  
very soluble in ether

Additional Data:

aniline equivalent, 19

specific gravity of gas (ideal)  
(air = 1.0), 3.4592

API gravity at 60°F., °API, 72.3

critical solution temperature,  
162.1°F.

critical pressure, 436 psia.

coefficient of expansion,  
0.00068 at 68°F.

total heating values (at 77°F.),  
20,614 Btu./lb.

117,980 Btu./cu. ft. - gas

liquid density in vacuo at 60°F.,  
5.7897 lbs./gal.

critical temperature, 496.9°F.

### 2,2,3-TRIMETHYL-2-BUTANOL

Synonyms:

tert-butyl dimethylcarbinol  
pentamethylethyl alcohol

Formula:  $(\text{CH}_3)_3\text{CC}(\text{CH}_3)_2\text{OH}$

Formula Weight: 116.2

Melting Point: 15 to 17°C.

Boiling Point: 131 to 132°C. (at 760 mm.)

Solubility:

insoluble in water  $\infty$  (in alcohol)  
 $\infty$  (in ether)

### 2,3,3-TRIMETHYL-1-BUTENE

Formula:  $(\text{CH}_3)_3\text{CC}(\text{CH}_3):\text{CH}_2$

Formula Weight: 98.2

Melting Point: -111.4°C.

Boiling Point: 77.9°C. (at 760 mm.)

Specific Gravity: 0.705 at 20°C.

### 1,3,5-TRIMETHYLCYCLOHEXANE

Synonyms: hexahydromesitylene

Formula:  $\text{C}_6\text{H}_9(\text{CH}_3)_3$

Formula Weight: 162.2

Boiling Point:

cis 140.0 to 140.5°C. (at 752 mm.)

trans 138.9 to 139.0°C. (at 754 mm.)

1,3,5-TRIMETHYLCYCLOHEXANE  
(Cont.)

Specific Gravity:

cis 0.773 at 20° C.trans 0.7720 at 20° C.

Refractive Index:

cis 1.43010trans 1.42740

## 3,3,5-TRIMETHYL-1-CYCLOHEXANOL

Synonyms:

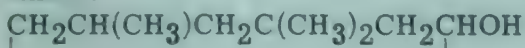
cyclonol

1-methyl-3-dimethylcyclohexanol

this is a commercial mixture of the

cis- and trans isomers

Formula:



Characteristics:

menthol-like aromatic odor

Formula Weight: 142.3

Boiling Point: 198° C. (at 760 mm.)

Specific Gravity:

0.878(20/20)0.891(20/4)7.3 lbs. per gal. at 20° C.Vapor Pressure (mm. Hg): 0.3 at 20° C.Flash Point: 165 to 180° F. (open)

Uses:

antifoaming agent

denaturant for alcohol in place of  
menthol

hydraulic fluids      textile soaps

insecticides      plasticizer

perfumes      wetting agents

substitute for menthol in cosmetics

Solubility:

insoluble in water

water is insoluble in it

## 3,5,5-TRIMETHYLCYCLOHEXANONE

Formula:  $(\text{CH}_3)_3\text{C}_6\text{H}_7\text{O}$ 

Formula Weight: 140.2

Boiling Point: 189° C. (at 760 mm.)

Specific Gravity: 0.889(20/4)

Flash Point: 175° F. (open)

Uses:

coupling agent for otherwise  
immiscible substances

## TRIMETHYLENE DIACETATE

Formula:  $(\text{CH}_3\text{COOCH}_2)_2\text{CH}_2$ 

Formula Weight: 160.2

Boiling Point: 209 to 210° C. (at 760 mm.)

Specific Gravity: 1.070 at 19° C.

Solubility (grams per 100 ml.):

10 (in water)

## TRIMETHYLENE DIBUTYRATE

Formula:  $(\text{C}_3\text{H}_7\text{COOCH}_2)_2\text{CH}_2$ 

Formula Weight: 216.3

Boiling Point: 125 to 130° C. (at 8 mm.)

Solubility:

insoluble in water

soluble in alcohol and ether

## 3,3,5-TRIMETHYL-4-HEPTENE

Synonyms: decylene

Formula:



Formula Weight: 140.3

Boiling Point: 157.5° C. (at 759 mm.)

Specific Gravity: 0.773(21/21)

## 2,2,5-TRIMETHYLHEXANE

Formula:  $\text{C}_9\text{H}_{20}$ 

Formula Weight: 128.3

Melting Point: -106° C.

Boiling Point: 124° C. (at 760 mm.)

Specific Gravity (in vacuo):

0.7071(20/4)0.7114(60/60)° F.5.93 lbs. per gal. at 60° F.

Refractive Index: 1.3996

Heat of Vaporization (Btu./lb.):

113.2 at the boiling point

134.66 at 77° F.

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 4.4276

API gravity at 60° F., °API, 67.4

critical solution temperature, 180.9° F.

critical temperature, 560° F.

coefficient of expansion,

0.00063 at 60 to 77° F.

total heating values (at 77° F.),

20,474 Btu./lb.

120,140 Btu./cu. ft. - gas

### N,1,5-TRIMETHYL-4-HEXENYLAMINE

Synonyms:

methylamino-2-methylheptene (6)

octin octinum

Formula:  $C_6H_{15}NHCH_3$

Characteristics: oily

Formula Weight: 141.3

Boiling Point: 176 to 178° C. (at 760 mm.)

Specific Gravity: 0.795

Solubility:

insoluble in water

soluble in alcohol, ether, and acids

### 2,2,3-TRIMETHYLPENTANE

Synonyms: octane

Formula:  $(CH_3)_3CCH(CH_3)C_2H_5$

Formula: 114.2

Melting Point: -112.3° C.

Boiling Point: 109.8° C. (at 760 mm.)

Specific Gravity:

0.717(20/4)

in vacuo: 0.71605(20/4),

0.72027(60/60)° F.

Refractive Index: 1.40295

Heat of Vaporization (Btu./lb):

121.1 at the boiling point

138.95 at 77° F.

Solubility:

insoluble in water soluble in ether

slightly soluble in alcohol

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 3.9434

API gravity at 60° F., °API, 65.0

liquid density in vacuo at 60° F.

(lbs./gal.), 6.0051

critical solution temperature, 159.3° F.

critical temperature, 545° F.

coefficient of expansion,

0.00062 at 32 to 104° F.

total heating values (at 77° F.),

20,564 Btu./lb.

122,200 Btu./cu. ft. - gas

### 2,2,4-TRIMETHYLPENTANE

Synonyms:

isobutyltrimethylpentane

isooctane

Formula:  $(CH_3)_3CCH_2CH(CH_3)_2$

Formula Weight: 114.2

Freezing Point: -107.4° C.

Boiling Point:

99.3° C. (at 760 mm.)

110.7° C. (at 760 mm.)

Specific Gravity:

0.7213

0.6918(20/4)

Refractive Index: 1.3916

Solubility:

insoluble in water soluble in ether

slightly soluble in alcohol

### 2,3,3-TRIMETHYLPENTANE

Synonyms: octane

Formula:  $C_2H_5C(CH_3)_2CH(CH_3)_2$

Formula Weight: 114.2

Melting Point: -101.5° C.

Boiling Point:

113.6 to 114.8° C. (at 760 mm.)

Specific Gravity: 0.726(20/4)

## 2,3,3-TRIMETHYLPENTANE (Cont.)

## Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## 2,3,4-TRIMETHYLPENTANE

Synonyms: octane

Formula:  $[(CH_3)_2CH]_2CHCH_3$

Formula Weight: 114.2

Melting Point:  $-110$  to  $-109.2^\circ C$ .

Boiling Point:  $113.4^\circ C$ . (at 760 mm.)

Specific Gravity:

0.720(20/4)

in vacuo: 0.71905(20/4),

0.72330 at (60/60° F.)

Refractive Index: 1.40422

Specific Heat (Btu./lb./° F. at  $71.1^\circ F$ ):  
0.515

Heat of Vaporization (Btu./lb.):

122.99 at the boiling point

141.92 at  $77^\circ F$ .

Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 3.9434

API gravity at  $60^\circ F$ ., °API, 64.1

liquid density in vacuo at  $60^\circ F$ .

(lbs./gal.), 6.0303

critical solution temperature,  $155.7^\circ F$ .

critical temperature,  $550^\circ F$ .

coefficient of expansion,

0.00061 at 32 to  $104^\circ F$ .

total heating values (at  $77^\circ F$ .),

20,572 Btu./lb.

122,760 Btu./cu. ft. - gas

## 2,2,4-TRIMETHYL-4-PENTANOL

Synonyms: octyl alcohol

Formula:  $(CH_3)_3CCH_2COH(CH_3)_2$

Formula Weight: 130.2

Melting Point:  $-20^\circ C$ .

Boiling Point:

146.5 to  $147.5^\circ C$ . (at 760 mm.)

Specific Gravity: 0.842 at  $0^\circ C$ .

Solubility:

insoluble in water    soluble in ether  
slightly soluble in alcohol

## 2,3,3-TRIMETHYL-1-PENTENE

Synonyms: octylene

Formula:  $C_2H_5C(CH_3)_2C(CH_3):CH_2$

Formula Weight: 112.2

Boiling Point:  $108.2^\circ C$ . (at 760 mm.)

Specific Gravity: 0.736(20/4)

## 2,4,4-TRIMETHYL-1-PENTENE

Synonyms: octylene

Formula:  $(CH_3)_3CCH_2C(CH_3):CH_2$

Formula Weight: 112.2

Melting Point:  $-93.6^\circ C$ .

Boiling Point:  $101.2^\circ C$ . (at 760 mm.)

Specific Gravity:

0.7151(20/4)

5.97 lbs. per gal. at  $20^\circ C$ .

Vapor Pressure (mm. Hg): 33.3 at  $20^\circ C$ .

Flash Point:  $20^\circ F$ . (closed)

Solubility:

insoluble in water  
water is insoluble in it

## 2,3,4-TRIMETHYL-2-PENTENE

Synonyms: octylene

Formula:  $(CH_3)_2CHC(CH_3):C(CH_3)_2$

Formula Weight: 112.2

Boiling Point:  $114.3^\circ C$ . (at 739 mm.)

## 2,4,4-TRIMETHYL-2-PENTENE

Synonyms: octylene

Formula:  $(CH_3)_2C:CHC(CH_3)_3$

Formula Weight: 112.2

Melting Point:  $-106.5^{\circ}\text{C}$ .

Boiling Point:  $104.5^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.7211(20/4)

6.01 lbs. per gal. at  $20^{\circ}\text{C}$ .

Vapor Pressure (mm. Hg): 33.6 at  $20^{\circ}\text{C}$ .

Flash Point:  $20^{\circ}\text{F}$ . (closed)

Solubility:

insoluble in water

water is insoluble in it

### 3,4,4-TRIMETHYL-2-PENTENE

Synonyms: octylene

Formula:  $(\text{CH}_3)_3\text{CC}(\text{CH}_3):\text{CHCH}_3$

Formula Weight: 112.2

Boiling Point:  $111.9^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 0.740(20/4)

### TRIMETHYLPHOSPHINE

Formula:  $(\text{CH}_3)_3\text{P}$

Formula Weight: 76.1

Boiling Point:  $40$  to  $42^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:  $<1$

Solubility:

insoluble in water    soluble in ether

### TRIOLEIN

Synonyms:

glycerol trioleate    glyceryl trioleate

Formula:  $(\text{C}_{17}\text{H}_{33}\text{COO})_3\text{C}_3\text{H}_5$

Characteristics: oily

Formula: 885.4

Melting Point:  $-4^{\circ}\text{C}$ .

Boiling Point:

$240^{\circ}\text{C}$ . (at 18 mm.)

with slight decomposition

Specific Gravity: 0.915 at  $15^{\circ}\text{C}$ .

Solubility:

insoluble in water

slightly soluble in alcohol

very soluble in ether

### TRIPHENYL PHOSPHITE

Synonyms: phenyl phosphite

Formula:  $(\text{C}_6\text{H}_5\text{O})_3\text{P}$

Formula Weight: 310.3

Boiling Point:  $360^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity: 1.184(18/18)

Solubility:

insoluble in water

soluble in alcohol, ether, chloroform,  
and benzene

### TRIPROPIONIN

Synonyms:

glycerol tripropionate

glyceryl tripropionate

Formula:  $(\text{C}_2\text{H}_5\text{COO})_3\text{C}_3\text{H}_5$

Formula Weight: 260.3

Boiling Point:  $177$  to  $182^{\circ}\text{C}$ . (at 20 mm.)

Specific Gravity: 1.100(20/18)

### TRIPROPYLAMINE

Formula:  $(\text{CH}_3\text{CH}_2\text{CH}_2)_3\text{N}$

Characteristics: amine odor

Formula Weight: 143.3

Melting Point:  $-93.5^{\circ}\text{C}$ .

Boiling Point:

$156^{\circ}\text{C}$ . (at 760 mm.)

$150$  to  $156^{\circ}\text{C}$ . (at 760 mm.)

Specific Gravity:

0.754(20/20)

0.757(20/4)

Refractive Index:

1.417 at  $20^{\circ}\text{C}$ .

1.41756 at  $19.4^{\circ}\text{C}$ .

Flash Point:  $105^{\circ}\text{F}$ . (open)

## TRIPROPYLAMINE (Cont.)

## Solubility:

very slightly soluble in water  
 ∞ (in alcohol and ether)  
 soluble in acetone, benzene, gasoline,  
 methanol, and ethyl acetate

## TRIPROPYL ORTHOFORMATE

Synonyms: propyl orthoformate

Formula:  $\text{HC}(\text{OCH}_2\text{CH}_2\text{CH}_3)_3$

Formula Weight: 190.3

Boiling Point: 196 to 198°C. (at 760 mm.)

Specific Gravity: 0.881(20/4)

Solubility (grams per 100 ml.):  
 2.1 at 22°C.

m-TRITOLYL PHOSPHITE

Synonyms: tricresyl phosphite

Formula:  $(\text{CH}_3\text{C}_6\text{H}_4\text{O})_3\text{P}$

Formula Weight: 352.4

Boiling Point: 235 to 238°C. (at 7 mm.)

p-TRITOLYL PHOSPHITE

Synonyms: tricresyl phosphite

Formula:  $(\text{CH}_3\text{C}_6\text{H}_4\text{O})_3\text{P}$

Characteristics: pale yellow

Formula Weight: 352.4

Boiling Point: 236 to 239°C. (at 7 mm.)

## TRIVALERIN

Synonyms:

glycerol trivalerate  
 glyceryl trivalerate

Formula:  $(\text{C}_4\text{H}_9\text{COO})_3\text{C}_3\text{H}_5$

Characteristics: pale yellow

Formula Weight: 344.4

Boiling Point: 152 to 155°C. (at 1 mm.)

Specific Gravity: 1.030 at 20°C.

## Solubility:

insoluble in water  
 soluble in alcohol and ether

## TURPENTINE

## Synonyms:

terebenthina

this is a mixture of oil and resin  
 procured from coniferous trees and  
 consists chiefly of pinene,  $\text{C}_{10}\text{H}_{16}$ .  
 The data below refer to steam  
 distilled turpentine.

Boiling Point: 155 to 173°C. (at 760 mm)

Specific Gravity:

0.857 at 20°C.

7.13 lbs. per gal. at 20°C.

Inflammability Range (volume per cent  
 in air): 0.8 (lower limit)

Flash Point:

95°F. (closed)

115°F. (open)

## Uses:

belt dressings

pharmaceuticals

camphor

perfumes

ceramics

petroleum refining

engraving

rubber cements

eucalyptol

sealing wax

insecticidal

general solvent

compounds

soaps

liniments

stove polishes

lubricants

synthetic leather

lithography

thinners

ointments

varnishes

paints

vermicides

## Solubility:

insoluble in water

soluble in alcohol, ether, chloroform,  
 and glacial acetic acid

## Additional Data:

coefficient of expansion,

0.00089 at 10 to 30°C.

autoignition temperature, 488°F.

## V

## VALERALDEHYDE

Synonyms: n-amyl aldehyde      n-valeric aldehyde  
pentanal

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CHO}$

Formula Weight: 86.1

Melting Point:  $-91.5^\circ\text{C}$ .

Boiling Point:  $103.4^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.819 at  $15^\circ\text{C}$ .      0.8185 at  $11^\circ\text{C}$ .

Refractive Index: 1.3882

Solubility:

slightly soluble in water

very soluble in alcohol and ether

## VALERIC ACID

Synonyms: pentanoic acid

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{COOH}$

Formula Weight: 102.1

Melting Point:

$-59^\circ\text{C}$ .       $-34.5^\circ\text{C}$ .

Boiling Point:

$184.4^\circ\text{C}$ . (at 760 mm.)

$187^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.942(20/4)      0.9435(15/4)

Refractive Index: 1.4086

Solubility (grams per 100 ml.):

3.7 at  $16^\circ\text{C}$ . (in water)

$\infty$  (in alcohol)       $\infty$  (in ether)

## VALERIC ANHYDRIDE

Synonyms: pentanoic anhydride

Formula:  $[\text{CH}_3(\text{CH}_2)_3\text{CO}]_2\text{O}$

Formula Weight: 186.3

Melting Point:  $-56.1^\circ\text{C}$ .

Boiling Point:

$215^\circ\text{C}$ . (at 760 mm.)

$218^\circ\text{C}$ . (at 760 mm.)

Specific Gravity:

0.922(17/4)

0.929(20/4)

Solubility:

decomposed by hot water

soluble in alcohol with decomposition

very soluble in ether

## VALERONITRILE

Synonyms:

n-butyl cyanide      pentanenitrile

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{CN}$

Formula Weight: 83.1

Melting Point:  $-96.0^\circ\text{C}$ .

Boiling Point:

$140.8^\circ\text{C}$ . (at 760 mm.)

$141^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.8014(20/4)

Refractive Index: 1.3909

Solubility:

insoluble in water      soluble in alcohol

soluble in ether

## VALEROPHENONE

Synonyms: butyl phenyl ketone

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{COC}_6\text{H}_5$

Formula Weight: 162.2

Boiling Point:

$239.5^\circ\text{C}$ . (at 760 mm.)

$248.5^\circ\text{C}$ . (at 760 mm.)

Solubility:

insoluble in water

very soluble in alcohol and ether

## VALERYL CHLORIDE

Synonyms: pentanoyl chloride

Formula:  $\text{CH}_3(\text{CH}_2)_3\text{COCl}$

Formula Weight: 120.6

Melting Point:  $-110.00^\circ\text{C}$ .

Boiling Point:  $127$  to  $128^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 1.016 at  $15^\circ\text{C}$ .

Refractive Index: 1.41555

Solubility:

decomposed by water and alcohol  
 $\infty$  (in ether)

## VINYL ACETATE

Synonyms: acetic acid vinyl ester

Formula:  $\text{CH}_3\text{COOCH}:\text{CH}_2$

Characteristics: mobile

Formula Weight: 86.1

Melting Point:  $< -60^\circ\text{C}$ .

Boiling Point:

$72$  to  $73^\circ\text{C}$ . (at  $760$  mm.)

$72.5^\circ\text{C}$ . (at  $760$  mm.)

$71.8$  to  $73^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:

0.932(20/4)

7.79 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.3941

Viscosity (centipoises): 0.43 at  $20^\circ\text{C}$ .

Flash Point:

$18^\circ\text{F}$ . (closed)       $30^\circ\text{F}$ . (open)

Specific Heat (Btu./lb.): 0.46

Heat of Vaporization (Btu./lb.): 163

Heat of Combustion (kilogram-calories  
per mole): 495

Uses:

organic syntheses    resins

Solubility (grams per 100 g.):

2.4 (in water)

soluble in alcohol and ether

Additional Data:

the commercial product is stabilized  
coefficient of expansion, 0.00155  
autoignition temperature,  $800^\circ\text{F}$ .

## VINYLAMINE

Synonyms: ethenylamine

Formula:  $\text{CH}_2:\text{CHNH}_2$

Formula Weight: 43.1

Boiling Point:  $56^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity: 0.832(20/4)

Solubility:

$\infty$  (in water)

soluble in alcohol

$\infty$  (in ether)

## 1-VINYL-3-CYCLOHEXENE

Synonyms:

3-cyclohexenylethylene

1-vinyl cyclohexene-3

4-vinyl cyclohexene-1

Formula:  $\text{C}_6\text{H}_9\text{CH}:\text{CH}_2$

Characteristics:

mobile

sharp, irritating odor

Formula Weight: 108.2

Boiling Point:

$130^\circ\text{C}$ . (at  $760$  mm.)

$126.5$  to  $133.5^\circ\text{C}$ . (at  $760$  mm.)

Specific Gravity:

0.830 to 0.835(15.5/15.5)

6.94 lbs. per gal. at  $20^\circ\text{C}$ .

Refractive Index: 1.4655

Flash Point:

$61^\circ\text{F}$ . (closed)

$74^\circ\text{F}$ . (open)

Uses:

organic syntheses of dyes, pharmaceuticals, plastics, polycarboxylic acids, resins, and other chemical intermediates

## Additional Data:

bromine number not less than 277  
 does not polymerize as readily as  
 styrene, vinyl chloride or the  
 acrylates  
 forms low molecular weight resins in  
 the presence of large amounts of  
 benzoyl peroxide or other free  
 radical producing agents  
 produces solid, insoluble polymers  
 with  $\text{AlCl}_3$ ,  $\text{BF}_3$  or other powerful  
 ionic type catalysts  
 the commercial product contains no  
 inhibitor  
 do not store above  $80^\circ\text{F}$ . or subject  
 to prolonged exposure to oxygen  
 containing gases  
 because of its nature as an unconju-  
 gated diolefinic hydrocarbon with  
 two isolated double bonds it under-  
 goes acylation, alkylation, dehydro-  
 genation, epoxidation, halogenation,  
 hydrogenation, and oxidation reactions

## VINYL ETHER

## Synonyms:

divinyl ether                      ethenyloxyethene

Formula:  $(\text{CH}_2\text{CH})_2\text{O}$

Formula Weight: 70.1

## Boiling Point:

$28.3^\circ\text{C}$ . (at 760 mm.)

$39^\circ\text{C}$ . (at 760 mm.)

Specific Gravity: 0.774 at 20/20

Inflammability Range (volume per cent  
 in air):

1.85 (lower limit)      36.5 (upper limit)

Flash Point:  $< -22^\circ\text{F}$ . (closed)

## Solubility:

insoluble in water       $\infty$  (in alcohol)  
     $\infty$  (in ether)

## VINYL SULFIDE

## Synonyms:

divinyl sulfide                      ethenylthioethene

Formula:  $(\text{CH}_2\text{CH})_2\text{S}$

## Characteristics:

mobile                      oily  
 characteristic odor

Formula Weight: 86.2

## Boiling Point:

$101^\circ\text{C}$ . (at 760 mm.)

$85$  to  $86^\circ\text{C}$ . (at 760 mm.)

## Specific Gravity:

0.9174 at  $15^\circ\text{C}$ .      0.912

Uses: organic syntheses

## Solubility:

slightly soluble in water  
 $\infty$  (in alcohol)                       $\infty$  (in ether)

## X

## XANTHIC ACID

Synonyms: xanthogenic acid

Formula:  $\text{CH}_3\text{CH}_2\text{OCSSH}$

Characteristics: oily

Formula Weight: 122.2

Melting Point:  $-53^\circ\text{C}$ .

## Boiling Point:

$24^\circ\text{C}$ . (at 760 mm.) with decomposition

Specific Gravity:  $>1$

## Solubility:

very slightly soluble in water

m-XYLENE

## Synonyms:

1,3-dimethylbenzene

m-xylolFormula:  $C_6H_4(CH_3)_2$ 

Formula Weight: 106.2

## Melting Point:

-53.6° C.

-47.9° C.

## Boiling Point:

138.8 to 139.1° C. (at 760 mm.)

## Specific Gravity:

0.8684 at 15° C.

0.8641(20/4)

0.867(17/4)

in vacuo 0.86412(20/4)

0.86875(60/60)° F.

## Refractive Index:

1.49962 at 14.9° C. 1.49715 at 20° C.

## Specific Heat (Btu./lb./° F. at 36.1° F.):

0.395

## Heat of Vaporization (Btu./lb.):

147.4 at the boiling point

172.75 at 77° F.

## Solubility:

insoluble in water

very soluble in alcohol and ether

## Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 3.6650

API gravity (at 60° F.), °API, 31.4

liquid density (in vacuo) at 60° F.,

7.2430 lbs./gal.

aniline point, -22° F.

critical temperature, 654.3° F.

critical pressure, 526 psia.

liquid coefficient of expansion,

0.00055 at 32 to 104° F.

weight of pure vapor, 4750 mg./l.

relative vapor density, 3.7

total heating values (at 77° F.),

18,434 Btu./lb.

132,280 Btu./cu. ft. - gas

o-XYLENE

## Synonyms:

1,2-dimethylbenzene

o-xylolFormula:  $C_6H_4(CH_3)_2$ 

Formula Weight: 106.2

Melting Point: -29 to -25.2° C.

Boiling Point: 144.4° C. (at 760 mm.)

## Specific Gravity:

0.8745(20/4)

0.881(20/4)

in vacuo 0.88005(20/4)

0.88465(60/60)° F.

## Refractive Index:

1.50777 at 15.5° C. 1.50523 at 20° C.

Inflammability Range (volume per cent  
in air):

1.0 (lower limit)

6.0 (upper limit)

## Flash Point:

63° F. (closed)

75° F. (open)

## Specific Heat (Btu./lb./° F. at 71.8° F.):

0.414

## Heat of Vaporization (Btu./lb.):

149.1 at the boiling point

157.9 at 77° F.

## Solubility:

insoluble in water

very soluble in alcohol and ether

## Additional Data:

autoignition temperature, 924° F.

vapor density, 3.66 to 3.7

specific gravity of gas (ideal)

(air = 1.0), 3.6650

API gravity (at 60° F.), °API, 28.5

liquid density (in vacuo) at 60° F.,

7.3755 lbs./gal.

aniline point, &lt; -22° F.

critical temperature, 677° F.

critical pressure, 542 psia.

liquid coefficient of expansion,

0.00054 at 32 to 104° F.

weight of pure vapor, 4750 mg./l.

total heating values (at 77° F.),

18,438 Btu./lb.

134,760 Btu./cu. ft. - gas

relative vapor density, 3.7

p-XYLENE

## Synonyms:

1,4-dimethylbenzene

p-xylolFormula:  $C_6H_4(CH_3)_2$ 

Formula Weight: 106.2

Melting Point: 13.2° C.

Boiling Point: 138.5° C. (at 760 mm.)

## Specific Gravity:

0.8611(20/4)

in vacuo 0.86100(20/4)

0.86569(60/60)° F.

## Refractive Index:

1.4942 at 23.4° C. 1.49580 at 20° C.

Specific Heat (Btu./lb./° F. at 79.5° F.):

0.407

Heat of Vaporization (Btu./lb.):

146.1 at the boiling point

171.61 at 77° F.

## Solubility:

insoluble in water

very soluble in alcohol and ether

## Additional Data:

specific gravity of gas (ideal)

(air = 1.0), 3.6650

API gravity (at 60° F.), °API, 32.0

liquid density (in vacuo) at 60° F.,

7.2174 lbs./gal.

aniline point, -22° F.

critical temperature, 652° F.

critical pressure, 514 psia.

liquid coefficient of expansion,

0.00056 at 68 to 104° F.

weight of pure vapor, 4750 mg./l.

relative vapor density, 3.7

total heating values (at 77° F.),

18,438 Btu./lb.

131,810 Btu./gal. - gas

## XYLENE

## Synonyms:

the commercial product is usually a

mixture of m, o, and p-xylenesFormula:  $C_6H_4(CH_3)_2$ 

Formula Weight: 106.2

Boiling Point: 127 to 159° C. (at 760 mm.)

## Specific Gravity:

0.862 at 20° C.

7.17 lbs. per gal. at 20° C.

Vapor Pressure (mm. Hg): 11 at 30° C.

Flash Point: 80° F. (closed)

## Uses:

artificial musk dye intermediates

dyes

organic syntheses

removal of naphthalene from illumi-  
nating gassolvent in manufacture of lacquers,  
rubber cements, and varnishes

## 2,3-XYLIDINE

## Synonyms:

2,3-dimethylaniline

vic-o-xylidineFormula:  $(CH_3)_2C_6H_3NH_2$ 

Formula Weight: 121.2

Melting Point: &lt; -15° C.

Boiling Point: 223.8° C. (at 760 mm.)

Specific Gravity: 0.991 at 15° C.

Refractive Index: 1.570

Flash Point: 206° F. (closed)

## Solubility:

very slightly soluble in water

very soluble in alcohol and ether

Additional Data: vapor density, 4.17

## 2,4-XYLIDINE

## Synonyms:

2,4-dimethylaniline

as-m-xylidineFormula:  $(CH_3)_2C_6H_3NH_2$ 

Formula Weight: 121.2

## Boiling Point:

213 to 214° C. (at 760 mm.)

216° C. (at 760 mm.)

## Specific Gravity:

0.974(20/4)

0.978(19.6/4)

0.9761(18/4)

## 2,4-XYLIDINE (Cont.)

Refractive Index: 1.559

## Solubility:

very slightly soluble in water  
soluble in alcohol, ether, and benzene

## 2,5-XYLIDINE

## Synonyms:

2,5-dimethylaniline  
p-xylidine

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{NH}_2$ 

Characteristics: oily

Formula Weight: 121.2

Melting Point: 15.5° C.

## Boiling Point:

217° C. (at 760 mm.)  
215° C. (at 739 mm.)

## Specific Gravity:

0.980 at 15° C.      0.979(21/4)

## Solubility (grams per 100 ml.):

0.980 (in alcohol)      soluble in ether  
very slightly soluble in water

## 2,6-XYLIDINE

## Synonyms:

2,6-dimethylaniline  
vic-m-xylidine

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{NH}_2$ 

Formula Weight: 121.2

## Boiling Point:

216 to 217° C. (at 760 mm.)  
216.9° C. (at 760 mm.)

## Specific Gravity:

0.980 at 15° C.      0.979

Refractive Index: 1.561

## Solubility:

insoluble in water      soluble in alcohol  
soluble in ether

## 3,5-XYLIDINE

## Synonyms:

3,5-dimethylaniline  
sym-m-xylidine

Formula:  $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{NH}_2$ 

Characteristics: oily

Formula Weight: 121.2

Boiling Point: 221 to 222° C. (at 760 mm.)

## Specific Gravity:

0.972(20/4)      0.9935 at 0° C.

Refractive Index: 1.558

Solubility: slightly soluble in water

p-XYLYL ACETATE

## Synonyms:

acetic acid p-xylyl ester  
p-tolubenzyl acetate

Formula:  $\text{CH}_3\text{COOCH}_2\text{C}_6\text{H}_4\text{CH}_3$ 

Formula Weight: 164.2

Boiling Point: 227° C. (at 760 mm.)

m-XYLYLAMINESynonyms: m-tolubenzylamineFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{NH}_2$ 

Characteristics: oily

Formula Weight: 121.2

Boiling Point: 205° C. (at 750 mm.)

Specific Gravity: 0.965(20/0)

## Solubility:

insoluble in water  
soluble in alcohol and ether

o-XYLYLAMINESynonyms: o-tolubenzylamineFormula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{NH}_2$ 

Characteristics: oily

Formula Weight: 121.2

Melting Point: 0° C.

Boiling Point: 205.6° C. (at 745 mm.)

Specific Gravity: 0.977(19/0)

p-XYLYLAMINE

Synonyms: p-tolubenzylamine

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{NH}_2$

Formula Weight: 121.2

Melting Point: 12.6 to 13.2° C.

Boiling Point: 204° C. (at 739 mm.)

Specific Gravity: 0.952(20/0)

Solubility:

very slightly soluble in water

## LIST OF SOURCES

The Table of constants of solvents was compiled from many sources, principally the booklets and data sheets issued by manufacturers of solvents, from reference texts and from journal articles. The list of these sources follows:

- B. Prager and P. Jacobson and F. Richter, eds., Beilsteins Handbuch der organischen Chemie. 4th Ed., 1st and 2nd Supplements, Springer, Berlin, 1918-1952.
- H. F. Coward and G. W. Jones. Limits of Inflammability of Gases and Vapors. U. S. Bur. Mines, Bull. 503 (1952)
- Carbide and Carbon Chemicals Corporation, Unit of Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
- Dow Chemical Company, Midland, Michigan.
- Stauffer Chemical Company, 420 Lexington Avenue, New York 17, N. Y.
- U. S. Industrial Chemicals, Inc., 60 East 42nd Street, New York, N. Y.
- Shell Development Company, 4560 Horton Street, Emeryville 8, California.
- Shell Chemical Corporation, 100 Bush Street, San Francisco 6, California.
- The Roessler & Hassiacher Chemical Company.
- Sharples Chemicals, Inc., 123 South Broad Street, Philadelphia 9, Pa.
- Gulf Oil Corporation-Gulf Refining Company, Gulf Building, Pittsburgh, Pa.
- Monsanto Chemical Company, St Louis 4, Missouri
- Ohio Apex, Inc., Nitro, W. Va.
- Hercules Powder Company, Wilmington, Delaware
- The Quaker Oats Company, 1950 Board of Trade Bldg., 141 West Jackson Blvd., Chicago 4, Illinois.
- Niacet Chemicals Corporation, Niagara Falls, New York.
- American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York 20 N. Y.
- Commercial Solvents Corporation, 17 East 42nd Street, New York 17, N. Y.
- Woburn Degreasing Company of New Jersey, Harrison, N. J.
- Hooker Electrochemical Company, Niagara Falls, N. Y.
- Electrochemicals Department, E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Delaware
- Phillips Petroleum Company, Bartlesville Oklahoma
- Morris B. Jacobs and Leopold Schefflan, Chemical Analysis of Industrial Solvents. Interscience, New York, 1953.
- Morris B. Jacobs, The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents. 2nd Ed., Interscience, New York, 1949.
- The Merck Index. 5th Ed. (1940), 6th Ed., Merck, Rahway, N. J., 1952.
- N. A. Lange, Handbook of Chemistry. 7th Ed., Handbook Publishers, Sandusky, O., 1949.
- C. H. Hodgman, ed., Handbook of Chemistry and Physics. 30th Ed., Chemical Rubber Publishing Co., Cleveland, O., 1948.

Useful Criteria in the Identification of Certain Occupational Health Hazards. Division of Industrial Hygiene, Utah State Department of Health, 1945.

Manual of Industrial Health Hazards. Joseph B. Ficklen. Service to Industry, Box 133, West Hartford, Conn.

Gnamm, Die Lösungsmittel und Weichhaltungsmittel. Wissenschaftliche Verlags, Stuttgart, 1943.

The Givaudan Index. Givaudan Delawanna, New York, 1949.

. Weissberger and E. S. Proskaver, Organic Solvents. Clarendon Press, Oxford, 1935.

Redwood's Treatise on Petroleum. 4th ed., vol. 1, 179 (1922).

H. Durrans, Lösungsmittel und Weichmachungsmittel. New supplement by O. Merz (1933).

H. Durrans, Solvents. Van Nostrand, New York, 1950.

. Holde, Kohlenwasserstofföle und Fette und die ihnen chemisch und technisch nahestehenden Stoffe. 7th ed., p.425(1933).

S. Hooper and C. A. Kraus, J. Am. Chem. Soc. 56, 2265 (1934).

R. Pyle. Phys. Rev. [2] 38, 1057 (1931).

Debye, Polare Molekeln. First Supplement.

. Herz and P. Schuftan, Z. physik. Chem. 101, 269 (1922).

Cohen and K. D. Dekker, Z. physik. Chem. 127, 183 (1927).

. Lautsch, Z. physik. Chem. [B] 1, 115 (1928)

Hartshorn and D. A. Oliver, Proc. Roy. Soc. 123 [A], 664 (1929).

K. Hojendahl, Thesis. Copenhagen (1928).

J. H. Mathews, J. Am. Chem. Soc. 48, 562 (1926).

Di Ciommox, Nuovo Cim. [5] 3, 97 (1903).

J. W. Williams and I. J. Krchma, J. Am. Chem. Soc. 48, 1888 (1926).

H. Poltz, O. Steil, and O. Strasser, Z. physik. Chem. [B] 17, 155 (1932).

J. Timmermans and F. Martin, J. Chim. phys. 23, 733 (1926).

N. Campbell, Phil. Mag. 23, 688 (1912).

T. W. Richards and J. W. Shipley, J. Am. Chem. Soc. 41, 2002 (1919).

F. Richter and W. Wolff, Ber. 63, 1721(1930).

J. Timmermans, Bull. Soc. chim. Belges. 30, 62 (1921).

J. C. Brown, J. Chem. Soc. 87, 265 (1905).

H. M. Huffman, G. S. Parks, and M. Barmore, J. Am. Chem. Soc. 53, 3876 (1931).

H. E. Patten, J. Phys. Chem. 6, 554 (1902).

W. Nernst, Z. physik. Chem. 14, 622(1894).

E. Bretscher, Physik. Z. 32, 765 (1931).

H. Becker, Wiss. Veröff. Siemens-Konz. 8, 2. Heft, 199 (1929).

S. Nametkin, J. Russ. Phys. Chem. Soc. 55, 75 (1923-4).

G. S. Parks and H. M. Huffman, J. Am. Soc. 52, 4381 (1930).

M. Godchot and G. Cauquil, Compt. rend. 192, 1560 (1931).

H. I. Waterman and H. A. Van Westen, Rec. trav. chim. 48, 637 (1929).

E. Sellner, Farbe u. Lack 178, 1412(1924).

C. Schall, Ber. 17, 2207 (1884).

- Siivola, Öfvers. Finska Vet.-Soc. 56, No. 8 (1913-14).
- A. L. Ward and S. S. Kurtz, Ind. Eng. Chem., Anal. Ed. 10, 559 (1938)
- O. Faust and G. Tamman, Z. physik. Chem. 71, 51 (1910).
- F. Tomaszewski, Ann. Physik [3] 33, 33 (1888).
- D. Tyrer, J. Chem. Soc. 105, 2534 (1914).
- P. Walden, H. Ulich, and F. Laun, Z. physik. Chem. 114, 275 (1925).
- K. L. Wolf and W. J. Gross, Z. physik. Chem. [B], 14, 305 (1931).
- J. Timmermans, Bull. Soc. Chim. Belges 25, 300 (1911).
- P. Pascal, Bull. Soc. Chim. [4] 13, 744 (1913).
- G. S. Parks, J. Am. Chem. Soc. 47, 338 (1925).
- P. S. Danner and J. H. Hildebrand, J. Am. Chem. Soc. 44, 2824 (1922).
- R. Abegg and W. Seitz, Z. Physik. Chem. 29, 242, 491 (1899).
- G. S. Parks and H. M. Huffman, J. Am. Chem. Soc. 48, 2788 (1926).
- W. Luginin, Ann. Chim. Phys. [7] 13, 289 (1898).
- J. W. Brühl, Ann. 200, 139 (1880)
- Rohm & Haas Company, Washington Square, Philadelphia 5, Pa.
- G. S. Parks and K. K. Kelley, J. Am. Soc. 47, 2089 (1925).
- J. L. Whitman and D. M. Hurt, J. Am. Soc. 52, 4762 (1930)
- W. Rudolph, Thesis. Leipzig, 1911.
- H. L. Donle, Z. Physik. Chem. [B] 14, 326 (1931).
- V. C. G. Trew and G. M. C. Watkins, Trans. Faraday Soc. 29, 1310 (1933).
- J. Timmermans and F. Martin, J. Chim. phys. 25, 411 (1928).
- P. Walden, Z. physik. Chem. 78, 275 (1912)
- A. O. Ball, J. Chem. Soc. 570 (1930).
- P. C. Mahanti and R. N. Das Gupta, Indian J. Phys. 3, 467 (1929).
- J. H. Mathews and P. R. Fehlandt, J. Am. Chem. Soc. 53, 3212 (1931).
- K. K. Kelley, J. Am. Chem. Soc. 51, 1400 (1929).
- G. Weissenberger and F. Schuster, Monats. 45, 413 (1924).
- J. W. Williams, J. Am. Chem. Soc. 52, 1831 (1930).
- P. Walden, Z. physik. Chem. 70, 569 (1910)
- J. W. Williams, Physik. Z. 29, 683 (1928).
- R. Muller, V. Raschka and M. Wittmann, Monatsh. 48, 659 (1927).
- C. P. Smyth and W. S. Walls, J. Am. Chem. Soc. 53, 2115 (1931).
- H. Landolt, Ann. Physik 122, 545 (1864).
- E. Beckmann, G. Fuchs, and V. Gernhardt, Z. physik. Chem. 18, 473, 509 (1895).
- G. E. Gibson and W. F. Giauque, J. Am. Chem. Soc. 45, 93 (1923).
- R. Bock, Z. Physik 31, 534 (1925).
- A. Schulze, Physik. Z. 13, 429 (1912).
- M. Rabinowitsch, Z. physik. Chem. 119, 59, 70 (1926).
- L. Meyer, Z. physik. Chem. [B] 8, 27 (1930).

- V. A. Roth and I. Meyer, Z. Elektrochem. 39, 35 (1933).
- V. Herz and E. Lorentz, Z. physik. Chem. 140, 406 (1929).
- . Ulich and W. Nespital, Z. physik. Chem. [B] 16, 221 (1932).
- . Sängewald and A. Weissberger, Physik. Z. 30, 268 (1929).
- . Hess, Ber. 63, 518 (1930).
- . Adkins and B. H. Nissen, J. Am. Chem. Soc. 44, 2749 (1922).
- . Walden and E. J. Birr, Z. physik. Chem. [A] 153, 1 (1931).
- . Matsuike, Sci. Rep. Tokoku Imp. Univ. 14, 445 (1925).
- . J. Markownikoff, J. Russ. Phys. Chem. Soc. 31, 357 (1899).
- . E. Garland and E. E. Reid, J. Am. Chem. Soc. 47, 2333 (1925).
- . Walden and E. J. Birr, Z. physik. Chem. [A] 165, 32 (1933).
- . L. Donle and G. Volkert, Z. physik. Chem. [B] 8, 60 (1930).
- . Livingston, R. Morgan, and O. M. Lammert, J. Am. Chem. Soc. 46, 881 (1924).
- . Hassel and E. Naeshagen, Z. physik. Chem. [B] 4, 217 (1929).
- . Luginin, Arch. sci. phys. nat. [4] 9, 5 (1900).
- . Kendall and E. Brakeley, J. Am. Chem. Soc. 43, 1826 (1921).
- . Sugden, J. Chem. Soc. 768 (1933).
- . V. Auwers and F. Eisenlohr, J. prakt. Chem. [2] 82, 65 (1910).
- . Timmermans and Hennaut-Roland, J. chim. Phys. 27, 401 (1930).
- H. W. Foote and G. Leopold, Am. J. Sci. [5] 11, 42 (1926).
- A. S. Coolidge, J. Am. Chem. Soc. 52, 1874 (1930).
- R. Schiff, Ann. 234, 300 (1886).
- T. E. Thorpe and J. W. Rodger, Phil. Trans. [A] 185, 397 (1894).
- P. Drude, Z. physik. Chem. 23, 267 (1897).
- K. L. Wolf, Physik. Z. 31, 227 (1930).
- W. R. Bousfield and T. M. Lowry, J. Chem. Soc. 99, 1432 (1911).
- C. Schall and C. Thieme-Wiedtmarkter, Z. Elektrochem. 35, 337 (1929).
- D. Marshall and W. Ramsey, Phil. Mag. [5] 41, 49 (1896).
- C. P. Smyth and H. E. Rogers, J. Am. Chem. Soc. 52, 1824 (1930).
- G. Briegleb, Z. physik. Chem. [B] 10, 205 (1930).
- W. Kurbatoff, J. Russ. Phys. Chem. Soc. 40, 1471, 1474, 1487 (1909).
- D. Berthelot, Ann. Chim. [5] 12, 529 (1877).
- P. Walden, Z. physik. Chem. 54, 129 (1906).
- C. T. Zahn, Physik. Z. 34, 570 (1933).
- F. Muller, Thesis, Braunschweig, 1928; Landolt-Börnstein, 2nd suppl, 11, 1196.
- T. E. Thorpe and J. W. Rodger, Phil. Trans. [A] 189, 74 (1897).
- J. Timmermans and Hennaut-Roland, J. chim. phys. 27, 529 (1932).
- D. Berthelot and Ogier, Compt. rend. 92, 669 (1881).
- A. Bartoli, Gazzeta 24 II, 156 (1894).

- H. Landolt and H. Jahn, Z. physik. Chem. 10, 289 (1892).
- C. P. Smyth and W. S. Walls, J. Am. Chem. Soc. 53, 527 (1931).
- T. M. Lowry, J. Chem. Soc. 105, 81 (1914).
- G. Weissenberger, F. Schuster, and H. Pamer, Monatsh. 46, 287 (1925).
- F. Baker, J. Chem. Soc. 103, 1661 (1913).
- G. Timofejew, Iswest. Kiew. polytech. Inst. 1905, I.
- J. Kendall and P. M. Gross, J. Am. Chem. Soc. 43, 1428 (1921).
- K. F. Löwe, Ann. Physik 66, 390 (1896).
- J. H. Mathews and K. E. Faville, J. Phys. Chem. 22, 1 (1918).
- R. Schiff, Z. physik. Chem. 1, 376 (1887).
- J. Timmermans, Bull. soc. chim. Belges 30, 213 (1921).
- J. C. Brown, J. Chem. Soc. 83, 993 (1903).
- R. Kremann, F. Gugl, and R. Meingast, Monatsh. 35, 1365 (1914).
- H. Müller and H. Sack, Physik. Z. 31, 815 (1930).
- T. Hannotte, Bull. soc. chim. Belges 35, 85 (1926).
- J. Timmermans, J. Bull. Soc. chim. Belges 24, 244 (1910).
- E. Biron, J. Russ. Phys. Chem. Soc. 42, 178 (1910).
- J. Timmermans, J. Bull. soc. chim. Belges 27, 334 (1914).
- A. Heydweiller, Ann. Physik 59, 193 (1896).
- L. A. Sayce and H. V. A. Briscoe, J. Chem. Soc. 2623 (1926).
- F. Eisenlohr, Z. physik. Chem. 75, 585 (1910).
- C. C. Miller, Proc. Roy. Soc. [A] 106, 724 (1924).
- K. V. Auwers and F. Eisenlohr, Z. physik. Chem. 83, 429 (1913).
- J. B. Senderens and J. Aboulenc, Compt. rend. 155, 1012 (1912).
- O. Hassel and E. Naeshagen, Z. physik. Chem. [B] 19, 434 (1932).
- S. J. Lumsden, J. Chem. Soc. 87, 94 (1905).
- R. Gartenmeister, Z. physik. Chem. 6, 524 (1890).
- W. Kurbatoff, J. Russ. Phys. Chem. Soc. 35, 319 (1903).
- W. H. Perkin, J. Chem. Soc. 69, 1187 (1896).
- D. Dobrosserdow, Sapiski Kasan (1909) 1.
- J. Kendall and J. E. Booge, J. Am. Chem. Soc. 38, 1719 (1916).
- C. A. Kohn and W. Trantom, J. Chem. Soc. 75, 1159 (1899).
- C. V. Rechenberg, Einfache und fraktionierte Destillation in Theorie und Praxis. Miltitz bei Leipzig (1923), p 228.
- M. A. Van Reis, Ann. Physik 13, 447 (1881).
- J. L. Sammis, J. Phys. Chem. 10, 593 (1906).
- A. T. Lincoln, J. Phys. Chem. 3, 465 (1899).
- C. A. Taylor and W. H. Rinkenbach, J. Am. Chem. Soc. 48, 1305 (1926).
- P. P. T. Sah and Shih-Liang Chien, J. Am. Chem. Soc. 53, 3901 (1931).
- C. Contzen-Crowet, Bull. soc. chim. Belges 35, 165 (1926).

- K. V. Auwers and A. Heinze, Ber. 52, 584 (1919).
- J. A. Handy and L. F. Hoyt, J. Am. Pharm. Assoc. 11, 928 (1922).
- E. Wertyporoch and B. Adams, Z. physik. Chem. [A] 168, 31 (1934).
- P. Walden, Z. physik. Chem. [A] 147, 1 (1930).
- L. Sanger, Physik. Z. 27, 556 (1926).
- J. P. Smyth, R. W. Dornte and E. B. Wilson, Jr, J. Am. Chem. Soc. 53, 4242 (1931).
- D. Berthelot and Ogier, Ann. Chim. phys. [5] 23, 225 (1881).
- A. E. Van Arkel and J. L. Snoek, Z. physik. Chem. [B] 18, 159 (1932).
- V. Narbutt, Ber. 52, 1031 (1919).
- Errera, Physik. Z. 27, 764 (1926).
- J. P. Smyth, S. O. Morgan, and J. C. Boyce, J. Am. Chem. Soc. 50, 1536 (1928).
- Y. Herz and W. Rathmann, Chem. Ztg. 37., 621 (1931).
- Y. Herz, Z. Elektrochem. 23, 24 (1917).
- J. Chavanne, Compt. rend. 154, 776 (1912); Bull. soc. chim. Belges 26, 287 (1912).
- J. Mehl, Z. ges. Kalteind. 41, 152 (1934).
- P. Walden and O. Werner, Z. physik. Chem. 111, 469 (1924).
- S. O. Morgan and H. H. Lowry, J. Phys. Chem. 34, 2385 (1930).
- J. P. Smyth and S. O. Morgan, J. Am. Chem. Soc. 50, 1547 (1928).
- B. Gates, J. Phys. Chem. 15, 97 (1911).
- J. P. Smyth and S. E. Kamerling, J. Am. Chem. Soc. 53, 2988 (1931).
- T. S. Patterson and D. Thomson, J. Chem. Soc. 93, 370 (1908).
- R. Weegmann, Z. physik. Chem. 2, 218 (1888).
- K. Brand and K. W. Kranz, J. prakt. Chem. [2] 115, 143 (1927).
- W. Luginin, Ann. chim. phys. [7] 27, 121 (1902).
- J. W. Williams and F. J. Daniels, J. Am. Chem. Soc. 46, 903 (1924).
- P. Walden, Bull. Acad. Sci. Petersbourg (1913) 564.
- F. Fairbrother, J. Chem. Soc. (1934) 1846.
- J. H. Awberry and E. Griffiths, Proc. Phys. Soc. 36, 303 (1924).
- H. R. Lang, Proc. Roy. Soc. [A] 118, 138 (1928).
- R. W. Lunt and M. A. G. Rau, Proc. Roy. Soc. [A] 126, 213 (1930).
- O. Hassel and A. H. Uhl, Z. physik. Chem. [B] 8, 187 (1930).
- W. Herz and E. Martin, Z. anorg. Chem. 132, 41 (1924).
- P. Walden, L. F. Audrieth, and E. J. Birr, Z. physik. Chem. [A] 160, 337 (1932).
- H. Schlundt, J. Phys. Chem. 5, 157, 503 (1901).
- L. Lange, Z. Physik. 33, 169 (1925).
- C. T. Zahn, Phys. Rev. 2, 35, 848 (1930).
- A. Karvonen, Ann. Acad. Sci. Fennicae [A] 10, No. 9, 6 (1916).
- W. H. Rinkenbach, Ind. Eng. Chem. 19, 474 (1927).
- J. G. Davidson, Ind. Eng. Chem. 18, 669 (1926).
- L. Schreiner, Ann. 197, 2 (1879).

- H. A. Schuette and P. T. Sah, J. Am. Chem. Soc. 48, 3161 (1926).
- H. A. Schuette and J. T. Hale, J. Am. Chem. Soc. 52, 1978 (1930).
- P. G. Gilchrist and H. A. Schuette, J. Am. Chem. Soc. 53, 3480 (1931).
- T. Posner and K. Rohde, Ber. 42, 3240 (1909).
- K. V. Aswers, Ann. 415, 98 (1918).
- F. M. Jaeger, Z. Anorg. Chem. 101, 1 (1917).
- A. Fairbourne, G. P. Gibson, and J. W. Stephens, J. Soc. Chem. Ind. 49, 1021 (1930).
- H. J. M. Creighton and H. Way, Franklin Inst. 186, 675 (1918).
- F. V. Grimm and W. A. Patrick, J. Am. Soc. 45, 2799 (1933).
- G. P. Smyth and W. S. Walls, J. Am. Chem. Soc. 54, 2261 (1932).
- P. A. Eckerlein, Ann. Physik. [4] 3, 120 (1900).
- G. H. Mains, Chem. & Met. Eng. 26, 779 (1922).
- W. V. Evans and M. B. Aylesworth, Ind. Eng. Chem. 18, 24 (1926).
- O. A. Pickett and J. M. Peterson, Ind. Eng. Chem. 21, 325 (1929).
- C. E. May and H. Hunt, Ind. Eng. Chem. 2, 384 (1928).
- R. F. Remler, Acetone. Its Production and Uses. National Wood Chemicals Association.

# INDEX OF SYNONYMS

## Explanatory Note

In order to avoid unnecessary duplication not all synonyms listed in the table text given in this index. Refer to the table text directly for synonyms as indicated below:

<u>Synonym</u>	<u>Refer to</u>
<u>Methanoate</u> compounds	<u>Formate</u> compounds
<u>Ethanoate</u> compounds	<u>Acetate</u> compounds
<u>Propanoate</u> compounds	<u>Propionate</u> compounds
<u>Butanoate</u> compounds	<u>Butyrate</u> compounds
<u>Pentanoate</u> compounds	<u>Valerate</u> compounds
<u>Hexanoate</u> compounds	<u>Caproate</u> compounds
<u>Chloromethanoate</u> compounds	<u>Chloroformate</u> compounds
<u>Chlorocarbonate</u> compounds	<u>Chloroformate</u> compounds
<u>Rhodanate</u> compounds	<u>Thiocyanate</u> compounds
<u>Sulfocyanate</u> compounds	<u>Thiocyanate</u> compounds
<u>Carbylamine</u> compounds	<u>Isocyanide</u> compounds
<u>Isonitrile</u> compounds	<u>Isocyanide</u> compounds
<u>Phenylacetate</u> compounds	<u><i>d</i>-Toluate</u> compounds
<u>Phenylethyl</u> compounds	<u>Phenethyl</u> compounds
<u>Mustard oil</u> compounds	<u>Isothiocyanate</u> compounds
<u><math>\gamma</math>-Methylbutyl</u> compounds	<u>Isoamyl</u> compounds
<u>Mono</u> compounds	Corresponding compound with mono deleted

The alphabetical arrangement of substituents in a compound is followed in the text; hence refer to the text, for instance, for butyl methyl ketone, for a synonym as methyl butyl ketone; under bromochloroethane for a synonym such as chlorobromoethane; etc. For many di compounds look under the corresponding compound with one deleted, e.g., for dimethyl carbonate see methyl carbonate. For di compounds such as those often termed diacetyl, diallyl, etc., refer to biacetyl, bialllyl. For ine compounds see the corresponding yne compound, as for decine refer to decyne. For synonyms using the abandoned "ether" and "ester" nomenclature, e.g., acetic ether and acetic ester, benzoic ether and benzoic ester, etc., refer to the corresponding ethyl compounds as ethyl acetate, ethyl benzoate, etc. For synonyms using the inverted ester nomenclature, as acetic acid ethyl ester, benzoic acid ethyl ester, etc. refer to the common nomenclature, namely, ethyl acetate, ethyl benzoate.

- Abalyn  
   See Methyl abietate  
 Acetol  
   See 1-Hydroxy-2-propanone  
 Acetaldehyde  
   See Acetaldehyde azine  
 Acetaldehyde cyanohydrin  
   See Lactonitrile  
 Acetaldehyde diethylacetal  
   See Acetal  
 Acetaldehyde dimethyl acetal  
   See 1,1-Dimethoxyethane  
 Acetalcohol  
   See Aldol  
 Acetdimethylamide  
   See N,N-Dimethylacetamide  
 Acetic aldehyde  
   See Acetaldehyde  
 Acetic ester  
   See Ethyl acetate  
 Acetic ether  
   See Ethyl acetate  
 Acetic oxide  
   See Acetic anhydride  
 Acetodichlorohydrin  
   See 2,3-Dichloropropyl acetate  
 Acetoethylamide  
   See Ethylacetamide  
 Acetol acetate  
   See Acetoxyacetone  
 Acetomesitylene  
   See 2,4,6-Trimethylacetophenone  
 Acetone cyanohydrin  
   See Hydroxyisobutyronitrile  
 Acetone alcohol  
   See Methanol  
 Acetone azine  
   See Ketazine  
 Acetone chloride  
   See 2,2-Dichloropropane  
 Acetonyl acetate  
   See Acetoxyacetone  
 Acetonylacetone  
   See Hexanedione  
 Acetonylacetophenone  
   See 1-Phenyl-1,4-pentanedione  
 Acetonyl alcohol  
   See 1-Hydroxy-2-propanone  
 Acetonyl chloride  
   See Chloro-2-propanone  
 Acetophenoneacetone  
   See 1-Phenyl-1,4-pentanedione  
 Acetylacetone  
   See 2,4-Pentanedione  
 o-Acetylaniline  
   See o-Aminoacetophenone  
 Acetylbenzene  
   See Acetophenone  
 Acetylcaproyl  
   See 2,3-Octanedione  
 Acetylcarbinol  
   See 1-Hydroxy-2-propanone  
 Acetyl cyanide  
   See Pyruvonnitrile  
 Acetyl diethylmalonate  
   See Diethyl acetylmalonate  
 Acetyl diethyl amine  
   See N,N-Diethylacetamide  
 Acetylenecarbinol  
   See 2-Propyn-1-ol  
 Acetylenecarboxylic acid  
   See Propiolic acid  
 Acetylene dibromide  
   See 1,2-Dibromoethylene  
 Acetylene dichloride  
   See 1,2-Dichloroethylene  
 Acetylene tetrabromide  
   See 1,1,2,2-Tetrabromoethane  
 Acetylene tetrachloride  
   See 1,1,2,2-Tetrachloroethane  
 Acetyl ethylmalonate  
   See Diethyl Acetylmalonate  
 Acetylformic acid  
   See Pyruvic acid  
 Acetyl hydride  
   See Acetaldehyde  
 Acetylmethyl acetate  
   See Acetoxyacetone  
 Acetyl oxide  
   See Acetic anhydride  
 2-Acetyl-1,3,3,4,4-pentamethylcyclopentene  
   See Desoxymesityl oxide  
 Acetylphenol  
   See Phenyl acetate  
 Acetylpropiophenone  
   See 1-Phenyl-1,4-pentanedione  
 Acetylresorcinol  
   See Resorcinol acetate  
 Acetylthymol  
   See Thymyl acetate  
 Acetyl tributylcitrate  
   See Tributyl acetylcitrate  
 Acetyl triethylcitrate  
   See Triethyl acetylcitrate  
 Acraldehyde  
   See Acrolein  
 Acroleic acid  
   See Acrylic acid  
 Acrylaldehyde  
   See Acrolein  
 Acrylic aldehyde  
   See Acrolein  
 Acrylic nitrile  
   See Acrylonitrile  
 Adipic ketone  
   See Cyclopentanone  
 Adipyl dinitrile  
   See Adiponitrile  
 Adronol  
   See Cyclohexanol  
 Aethon  
   See Ethyl orthoformate  
 "Albolene"  
   See Petrolatum (Liquid)  
 Alcohol  
   See Ethyl alcohol  
 Aldehyde  
   See Acetaldehyde  
 Aldehyde cyanohydrin  
   See Lactonitrile  
 Alexipon  
   See Ethyl acetylsalicylate  
 Alkazene 3  
   See x-Triethylbenzene  
 Alkazene 12  
   See x-Diisopropylbenzene  
 Alkazene 13  
   See x-Triisopropylbenzene  
 Alkazene 20  
   See 3-Chloroethylbenzene  
 Alkazene 21  
   See 4-Chloroethylbenzene  
 Alkazene 40  
   See x-Bromoethylbenzene  
 Alkazene 42  
   See x-Dibromoethylbenzene  
 Alkazene 47  
   See x-Bromoisopropylbenzene  
 Alkazene 60  
   See x-Chloroisopropylbenzene  
 Allylactic acid  
   See 4-Pentenoic acid  
 Allylacetone  
   See 5-Hexen-2-one  
 Allylacetoneitrile  
   See 4-Pentenitrile  
 Allylaldehyde  
   See Acrolein  
 p-Allylanisole  
   See Estragole  
 Allyl bromide  
   See 3-Bromopropene  
 Allylcarbinol  
   See 3-Buten-1-ol

yl chloride  
 See 3-Chloropropene  
 yl cyanide  
 See 3-Butenenitrile  
 yl diglycol carbonate  
 See Diethylene glycol bis  
 allylcarbonate)  
 ylene dichloride  
 See 1,2-Dichloro-1-propene  
 ylene oxide  
 See 1,2-Epoxypropene  
 Allylethyl alcohol  
 See 4-Penten-1-ol  
 Allylguaiacol  
 See Eugenol  
 yl iodide  
 See 3-Iodopropene  
 yl mercaptan  
 See 2-Propene-1-thiol  
 ylmethanol  
 See 3-Buten-1-ol  
 Allyl-2-methoxyphenol  
 See Eugenol  
 ylmethylcarbinol  
 See 4-Penten-2-ol  
 ylmethyl cyanide  
 See 4-Pentenitrile  
 Allyl-3,4-methylenedioxy-  
 benzene  
 See Safrole  
 allylphenol  
 See Chavicol  
 ylphthalate  
 See Diallyl phthalate  
 yl thioether  
 See Allyl sulfide  
 yl tribromide  
 See 1,2,3-Tribromopropane  
 yl trichloride  
 See 1,2,3-Trichloropropane  
 nioanisole  
 See Anisidine  
 nobenzene  
 See Aniline  
 nobutane  
 See Butylamine  
 nochlorobenzene  
 See Chloroaniline  
 nocyclohexane  
 See Cyclohexylamine  
 mino-p-cymene  
 See Carvacrylamine  
 minodecane  
 See Decylamine  
 mino-2,2-dimethyl-  
 propane  
 See  $\beta,\beta$ -Dimethyl-  
 propylamine

Aminoethane  
 See Ethylamine  
 Aminoethoxybenzene  
 See Phenetidine  
 $\beta$ -Aminoethyl alcohol  
 See Aminoethanol  
 Aminoethylbenzene  
 See Ethylaniline  
 2-Aminoethylethanolamine  
 See 2-(2-Aminoethyl-  
 aminoethanol)  
 Aminofluorobenzene  
 See Fluoroaniline  
 1-Aminohendecane  
 See Hendecylamine  
 1-Aminoheptane  
 See Heptylamine  
 2-Aminoisobutane  
 See tert-Butylamine  
 4-Aminoisodurene  
 See 2,3,4,6-Tetramethyl-  
 aniline  
 $\alpha$ -Aminoisopropyl alcohol  
 See 1-Amino-2-propanol  
 Aminomenthane  
 See 1-Menthylamine  
 Aminomethoxybenzene  
 See Anisidine  
 1-Amino-3-methylbutane  
 See Isoamylamine  
 3-Amino-2-methyl-n-butane  
 See  $\alpha,\beta$ -Dimethylpropyl-  
 amine  
 1-Amino-2-methylpropane  
 See Isobutylamine  
 1-Aminononane  
 See Nonylamine  
 1-Aminooctane  
 See Octylamine  
 2-Aminooctane  
 See 1-Methylheptylamine  
 1-Aminopentane  
 See Amylamine  
 Aminophen  
 See Aniline  
 Aminophenetole  
 See Phenetidine  
 1-Amino-2-phenylethane  
 See Phenethylamine  
 Aminophenylethyl ether  
 See Phenetidine  
 $o$ -Aminophenyl methyl ketone  
 See  $o$ -Aminoacetophenone  
 1-Aminopropane  
 See Propylamine  
 2-Aminopropane  
 See Isopropylamine

3-Aminopropylene  
 See Allylamine  
 Aminotoluene  
 See Benzylamine  
 Amoxybenzene  
 See Amyl phenyl ether  
 Amphetamine  
 See Benzedrine  
 Amyl acetic ester  
 See Amyl acetate  
 $n$ -Amylacetylene  
 See 1-Heptyne  
 Amyl alcohol, fermentation  
 See Fusel oil  
 $sec$ -act-Amyl alcohol  
 See 2-Pentanol  
 $d$ -pri-act-Amyl alcohol  
 See 2-Methyl-1-butanol  
 $sec$ - $n$ -Amyl alcohol  
 See 3-Pentanol  
 $n$ -Amyl aldehyde  
 See Valeraldehyde  
 Amylamine  
 See 1-Amino-2-methyl-  
 butane  
 Amylamine  
 See Dimethylpropylamine  
 $sec$ - $n$ -Amylamine  
 See  $\alpha$ -Methylbutylamine  
 $sec$ -Amylbenzene  
 See Diethylphenylmethane  
 Amyl bromide  
 See 1-Bromopentane  
 Amyl bromide  
 See 1-Bromo-2,2-dimethyl-  
 propane  
 $d$ -prim-act-Amyl bromide  
 See 1-Bromo-2-methyl butane  
 tert-Amyl bromide  
 See 2-Bromo-2-methylbutane  
 Amyl butanedioate  
 See Amyl succinate  
 Amylcarbinol  
 See Hexyl alcohol  
 Amyl chloride  
 See Chloropentane  
 Amyl chloride  
 See Chloromethylbutane  
 Amyl cyanide  
 See Capronitrile  
 Amyldiethylcarbinol  
 See 3-Ethyl-3-octanol  
 Amyldiethylmethanol  
 See 3-Ethyl-3-octanol  
 Amyldimethylmethane  
 See 2-Methylheptane  
 Amylene  
 See Pentene

Amylene dichloride  
   See Dichloropentanes  
 Amylene glycol  
   See Pentanediol  
 Amylene hydrate  
   See *tert*-Amyl alcohol  
*act*-Amyl ethyl ether  
   See Ethyl 2-methylbutyl ether  
 Amyl ethyl ketone  
   See 3-Octanone  
 Amylethylmethylmethane  
   See 3-Methyloctane  
*n*-Amyl fluoride  
   See 1-Fluoropentane  
 Amyl hydride  
   See Pentane  
 Amylic ether  
   See Amyl ether  
 Amyl iodide  
   See Iodopentane  
*tert*-Amyl iodide  
   See 2-Iodo-2-methylbutane  
*pri-act*-Amyl iodide  
   See 1-Iodo-2-methylbutane  
 Amyl mercaptan  
   See 1-Pentanethiol  
*pri-act*-Amyl mercaptan  
   See 2-Methyl-1-butanethiol  
 Amylmethylacetylene  
   See 2-Octyne  
 Amylmethylcarbinol  
   See 2-Heptanol  
 Amyl methyl ketone  
   See 2-Heptanone  
 Amyl oxide  
   See Amyl ether  
 Amyl phosphate  
   See Triamyl phosphate  
 Amyl phthalate  
   See Diamyl phthalate  
 Amylpropylcarbinol  
   See 4-Nonanol  
 Aniline oil  
   See Aniline  
 Anise camphor  
   See Anethole  
 Anisic Aldehyde  
   See Anisaldehyde  
 Anisoil  
   See Anisole  
 Anisol  
   See Anisole  
 Anol  
   See Cyclohexanol  
 Antimony triethyl  
   See Triethylantimony

Antimony trimethyl  
   See Trimethylantimony  
 Arheol  
   See *d*-Santalol  
 Arsenic dimethyl  
   See Cacodyl  
 Arsenic triethyl  
   See Triethylarsine  
 Arsenic trimethyl  
   See Trimethylarsenic  
 Arsinoethane  
   See Ethylarsine  
 Aubepine  
   See Anisaldehyde  
 Azine  
   See Pyridine  
 Azole  
   See Pyrrole  
  
 Banana Oil  
   See Isoamyl acetate  
 Benzal bromide  
   See *d,d*-Dibromotoluene  
 Benzal chloride  
   See 2,*d*-Dichlorotoluene  
*dl*-Benzaldehyde cyanohydrin  
   See *dl*-Mandelonitrile  
 1-Benzazine  
   See Quinoline  
 Benzazine  
   See Isoquinoline  
 Benzenecarbonal  
   See Benzaldehyde  
 Benzenecarbonitrile  
   See Benzonitrile  
 Benzenecarbonyl bromide  
   See Benzoyl bromide  
 Benzenecarbonyl chloride  
   See Benzoyl chloride  
 Benzenecarbonyl fluoride  
   See Benzoyl fluoride  
 Benzenecarbothioic acid  
   See Thiolbenzoic acid  
 Benzene hexahydride  
   See Cyclohexane  
 Benzene sulfide  
   See Phenyl sulfide  
 Benzene tetrahydride  
   See Cyclohexene  
 Benzenyl Trichloride  
   See *d,d,d*-Trichlorotoluene  
 Benzfuran  
   See 3(2)-Benzofuran  
 Benzine  
   See Naphtha  
 Benzien  
   See Petroleum ether

Benzinum purificatum  
   See Petroleum ether  
 Benzofuranone  
   See 3(2)-Benzofuran  
 Benzoic aldehyde  
   See Benzaldehyde  
 Benzoic nitrile  
   See Benzonitrile  
 Benzoic trichloride  
   See *d,d,d*-Trichlorotoluene  
 Benzol  
   See Benzene  
 Benzo(b)pyridine  
   See Quinoline  
 Benzo(c)pyridine  
   See Isoquinoline  
 Benzotrichloride  
   See *d,d,d*-Trichlorotoluene  
 Benzotrifluoride  
   See *d*-Trifluorotoluene  
 Benzoyl hydride  
   See Benzaldehyde  
 Benzoylmethide  
   See Acetophenone  
 Benzylacetone  
   See 4-Phenyl-2-butanone  
 Benzylbenzene  
   See Diphenylmethane  
 Benzyl bichloride  
   See *d,d*-Dichlorotoluene  
 Benzyl bromide  
   See *d*-Bromotoluene  
 Benzylcarbinol  
   See Phenethyl alcohol  
 Benzylcarbonyl chloride  
   See Benzoyl chloride  
 Benzyl chloride  
   See *d*-Chlorotoluene  
 Benzyl cyanide  
   See *d*-Tolunitrile  
 Benzyl dichloride  
   See *d,d*-Dichlorotoluene  
 Benzylene chloride  
   See *d,d*-Dichlorotoluene  
 Benzyl ethyl ketone  
   See 1-Phenyl-2-butanone  
 Benzyl fluoride  
   See *d*-Fluorotoluene  
*d*-Benzylhydroxylamine  
   See Benzyloxyamine  
 Benzylidene bromide  
   See *d,d*-Dibromotoluene  
 Benzylidene chloride  
   See *d,d*-Dichlorotoluene  
*d*-Benzyl isopropyl alcohol  
   See Benzyl dimethyl methanol

- 1-Benzylxybutane  
   See Benzyl butyl ether  
 Bergamiol  
   See 1-Linalool acetate  
 Bi-sec-butyl  
   See 3,4-Dimethylhexane  
 Bichloroacetic acid  
   See Dichloroacetic acid  
 Bicyclo (4,4,0)-decane  
   See cis-Decalin  
 Biformyl  
   See Glyoxal  
 Bihexyl  
   See Dodecane  
 Biisoamyl  
   See 2,7-Dimethyloctane  
 Biisobutyl  
   See 2,5-Dimethylhexane  
 Biisopropenyl -  
   See 2,3-Dimethyl-1,3-butadiene  
 Biisopropyl  
   See 2,3-Dimethylbutane  
 Bioctyl  
   See Hexadecane  
 Bipropargyl  
   See 1,5-Hexadiyne  
 Bipropenyl  
   See 2,4-Hexadiene  
 N,N'-Bis (2-aminoethyl) ethylenediamine  
   See Triethylenetetramine  
 Bis-(Diethylene glycol monoethyl ether phthalate)  
   See "Carbitol" phthalate  
 Bisdimethylarsenic sulfide  
   See Cacodyl sulfide  
 Bis- $\beta$ -ethoxyethyl ether  
   See Diethyl Carbitol  
 Bis- $\beta$ -hydroxyethyl sulfide  
   See 2,2'-Thiodiethanol  
 Bis (2-hydroxypropyl) ether  
   See Dipropylene glycol  
 Bis-( $\gamma$ -methylbutyl)amine  
   See Diisoamylamine  
 Bis ( $\gamma$ -methylbutyl ethanedioate)  
   See Isoamyl oxalate  
 Bis-( $\beta$ -methylpropyl) amine  
   See Diisobutylamine  
 Bis ( $\beta$ -methylpropyl) ethanedioate  
   See Isobutyl oxalate  
 Bromacetal  
   See 2,2-Dibromopropane  
 Bromic ether  
   See Bromoethane  
 Bromoacetone  
   See 1-Bromo-2-propanone  
 $\beta$ -Bromoallyl alcohol  
   See  $\alpha$ -Bromo- $\alpha$ -propen-1-ol  
 $\alpha$ -Bromoallyl bromide  
   See 2,3-Dibromopropylene  
 $\gamma$ -Bromoallylene  
   See 3-Bromopropyne  
 Bromobenzol  
   See Bromobenzene  
 o-Bromobenzyl chloride  
   See o-Bromo- $\alpha$ -chloro-toluene  
 $\beta$ -Bromodiethyl ether  
   See  $\beta$ -Bromoethyl ethyl ether  
 2-Bromoethanol acetate  
   See  $\beta$ -Bromoethyl acetate  
 Bromoethanoyl bromide  
   See Bromoacetyl bromide  
 Bromoethene  
   See Bromoethylene  
 1-Bromo-2-ethoxyethane  
   See  $\beta$ -Bromoethyl ethyl ether  
 $\beta$ -Bromoethyl alcohol  
   See 2-Bromo-1-ethanol  
 $\beta$ -Bromoethyl ether  
   See  $\beta$ -Bromoethyl ethyl ether  
 $\beta$ -Bromoethyl phenyl ether  
   See  $\beta$ -Bromophenetole  
 p-Bromoisopropylbenzene  
   See p-Bromocumene  
 2-Bromo-4-isopropyl-1-methylbenzene  
   See 2-Bromo-p-cymene  
 1-Bromo-2-methoxybenzene  
   See  $\alpha$ -Bromoanisole  
 Bromomethyl cyanide  
   See Bromoacetonitrile  
 2-Bromopentanoic acid  
   See  $\alpha$ -Bromovaleric acid  
 1-Bromo-1-phenylethane  
   See  $\alpha$ -Bromoethylbenzene  
 1-Bromo-2-phenylethene  
   See  $\beta$ -Bromoethylbenzene  
 Bromophenylethylene  
   See Bromostyrene  
 Bromophenyl ethyl ether  
   See Bromophenetole  
 o-Bromophenyl methyl ether  
   See o-Bromoanisole  
 Bromophosgene  
   See Carbonyl bromide  
 Bromoprene  
   See 2-Bromo-1,3-butadiene  
 2-Bromopropenyl  
   See 2-Bromopropene  
 $\beta$ -Bromopropyl alcohol  
   See 2-Bromo-1-propanol  
 1, $\alpha$ -Bromopylene  
   See 1-Bromopropene  
 $\alpha$ -Bromostyrol  
   See  $\alpha$ -Bromostyrene  
 Bromotrimethylmethane  
   See 2-Bromo-2-methylpropane  
 Bromovinylbenzene  
   See  $\alpha$ -Bromostyrene  
 Butadiene monoxide  
   See 3,4-Epoxy-1-butene  
 Butaldehyde  
   See Butyraldehyde  
 Butanal  
   See Butyraldehyde  
 Butanal oxime  
   See Butyraldehyde oxime  
 Butanedial  
   See Succinaldehyde  
 2,3-Butanedione  
   See Biacetyl  
 Butanedioyl chloride  
   See Succinyl chloride  
 Butanenitrile  
   See Butyronitrile  
 Butanoic acid  
   See Butyric acid  
 Butanoic anhydride  
   See Butyric anhydride  
 Butanol  
   See Butyl alcohol  
 2-Butanol acetate  
   See sec-Butyl acetate  
 3-Butanolal  
   See Aldol  
 Butanolamine  
   See 2-Amino-1-butanol  
 Butanolide  
   See Butyrolactone  
 Butanoxime  
   See 2-Butanone oxime  
 Butanoyl bromide  
   See Butyryl bromide  
 Butanoyl chloride  
   See Butyryl chloride  
 2-Buten-1-al  
   See Crotonaldehyde  
 2-Butenenitrile  
   See Crotononitrile  
 2-Buten-1-ol acetate  
   See 2-Butenyl acetate  
 2-Butenoic anhydride  
   See Crotonic anhydride

- $\beta$ -Butenonitrile  
 See 3-Butenenitrile  
 Butenyne  
 See 3-Buten-1-yne  
 Butoxybenzene  
 See Butyl phenyl ether  
 1-Butoxybutane  
 See Butyl ether  
 2-Butoxy-1-ethanol  
 See Butyl "Cellosolve"  
 $\beta$ -Butoxy- $\beta$ -ethoxyethyl acetate  
 See Butyl "Carbitol" acetate  
 Butoxylethyl diglycol carbonate  
 See Diethylene glycol bis(2-butoxyethyl carbonate)  
 Butoxy ethyl stearate  
 See Butyl "Cellosolve" stearate  
 Butoxy glycol phthalate  
 See Butyl "Cellosolve" phthalate  
 Butoxytoluene  
 See Butyl tolyl ether  
 Butylacetic acid  
 See Caproic acid  
 Butylacetylene  
 See 1-Hexyne  
 Butyl aldehyde  
 See Butyraldehyde  
 Butylamine  
 See Dibutylamine  
 Butyl benzenecarboxylate  
 See Butyl benzoate  
 Butyl borate  
 See Tributyl borate  
 Butyl bromide  
 See Bromobutane  
tert-Butyl bromide  
 See 2-Bromo-2-methylpropane  
 Butyl carbinol  
 See Amyl alcohol  
d-sec-Butylcarbinol  
 See 2-Methyl-1-butanol  
 Butyl chloral  
 See 2,2,3-Trichlorobutyraldehyde  
 Butyl chloride  
 See Chlorobutane  
tert-Butyl chloride  
 See 2-Chloro-2-methylpropane  
 Butyl 2-chloroethanoate  
 See Butyl chloroacetate  
 n-Butyl citrate  
 See Tributyl citrate  
 n-Butyl cyanide  
 See Valeronitrile  
sec-Butyl cyanide  
 See  $\alpha$ -Methylbutyronitrile  
 Butyl cresyl ether  
 See Butyl tolyl ether  
tert-Butyl cyanide  
 See  $\alpha,\alpha$ -Dimethylpropionitrile  
 Butyl diglycol carbonate  
 See Diethylene glycol bis(butyl carbonate)  
 Butyldimethylcarbinol  
 See 2-Methyl-2-hexanol  
tert-Butyldimethylcarbinol  
 See 2,2,3-Trimethyl-2-butanol  
 1-Butyldithiobutane  
 See Butyl disulfide  
 Butylene bromide  
 See Dibromobutane  
 Butylene chloride  
 See 1,2-Dichlorobutane  
 $\beta$ , $\gamma$ -Butylene chlorohydrin  
 See 3-Chloro-2-butanol  
 $\alpha$ -Butylene dibromide  
 See 1,3-Dibromobutane  
 Butylene glycol  
 See Butanediol  
 Butylene hydrate  
 See sec-Butyl alcohol  
 Butylene isobromide  
 See 1,1-Dibromo-2-methylpropane  
 Butyl ethanedioate  
 See Butyl oxalate  
 Butylethylacetaldehyde  
 See 2-Ethylcaproaldehyde  
 Butylethylacetylene  
 See 3-Octyne  
 Butylethylene  
 See 1-Hexene  
sec-Butylethylene  
 See 3-Methyl-1-pentene  
 Butyl ethyl ketone  
 See 3-Heptanone  
 Butylethylmethylcarbinol  
 See 3-Methyl-3-heptanol  
 Butylethylmethylmethane  
 See 3-Methylheptane  
sec-Butylethylmethylmethane  
 See 3,4-Dimethylhexane  
n-Butyl fluoride  
 See 1-Fluorobutane  
 Butyl o-hydroxybenzoate  
 See Butyl salicylate  
 Butyl 12-hydroxy-9-octadecenoate  
 See Butyl ricinoleate  
 Butylidene dichloride  
 See 1,1-Dichlorobutane  
 Butyl iodide  
 See Iodobutane  
tert-Butyl iodide  
 See 2-Iodo-2-methylpropane  
 Butyl mercaptan  
 See 1-Butanethiol  
tert-Butyl mercaptan  
 See 2-Methyl-2-propanethiol  
 Butyl methanol  
 See Amyl alcohol  
 Butylmethylacetylene  
 See 2-Heptyne  
tert-Butylmethylamine  
 See  $\beta,\beta$ -Dimethylpropylamine  
 Butylmethylcarbinol  
 See 2-Hexanol  
 1-Butyl-2-methylethylene  
 See 2-Heptene  
 n-Butyl methyl ketone  
 See 2-Hexanone  
sec-Butyl methyl ketone  
 See 3-Methyl-2-pentanone  
tert-Butyl methyl ketone  
 See Pinacolone  
 Butyl octadecanoate  
 See Butyl stearate  
 Butyl 9-octadecenoate  
 See Butyl oleate  
 Butyl phenyl carbinol  
 See Butylphenylmethanol  
 Butyl phenyl ketone  
 See Valerophenone  
 n-Butyl phosphate  
 See Tributyl phosphate  
 Butyl phthalate  
 See Dibutyl phthalate  
 Butyl thiobutane  
 See Butyl sulfide  
 1-Butynylbenzene  
 See 1-Phenyl-1-butyne  
 p-Butyraldehyde  
 See Butyraldehyde trimer  
 Butyraldoxime  
 See Butyraldehyde oxime  
 Butyrchloral  
 See 2,2,3-Trichlorobutyraldehyde  
 Butyric alcohol  
 See Etyl alcohol  
 Butyric aldehyde  
 See Butyraldehyde

- Butyrin  
   See Tributyrin  
 Butyrone  
   See 4-Heptanone  
 Butyrylbenzene  
   See Butyrophenone  
 Butyryl oxide  
   See Butyric anhydride  
 Cacodyl hydride  
   See Dimethylarsine  
 Cajepentine  
   See Dipentene  
 Cajeputole  
   See Cineole  
 Cantharene  
   See  $\alpha,\alpha$ -Dihydro-*o*-xylene  
 Canadol  
   See Petroleum ether  
 Capric aldehyde  
   See Capraldehyde  
 Capric nitrile  
   See Caprinitrile  
 Caprylic acid  
   See Caprylic acid  
 Caprinaldehyde  
   See Capraldehyde  
 Caproic acid nitrile  
   See Isocapronitrile  
 Caproic nitrile  
   See Capronitrile  
*n*-Caprone  
   See 6-Hendecanone  
 Capronic acid  
   See Caproic acid  
 Capronic ether  
   See Ethyl caproate  
 Caproyl hydride  
   See Hexane  
 Capryl alcohol  
   See Octyl alcohol  
 Capryl alcohol  
   See 2-Octanol  
*sec*-*n*-Caprylamine  
   See 1-Methylheptylamine  
 Capryl bromide  
   See 1-Bromooctane  
 Caprylene  
   See 1-Octene  
 Capryl ether  
   See Allyl caproate  
 Caprylic alcohol  
   See Octyl alcohol  
 Caprylic aldehyde  
   See Caprylaldehyde  
 Caprylic bromide  
   See 1-Bromooctane  
 Caprylidene  
   See 1-Octyne
- Carbanil  
   See Phenyl Isocyanate  
 Carbinol  
   See Methanol  
 Carbon bichloride  
   See Tetrachloroethylene  
 Carbon bisulfide  
   See Carbon disulfide  
 Carbon dichloride  
   See Tetrachloroethylene  
 Carbon oxybromide  
   See Carbonyl bromide  
 Carbonyl disulfethyl  
   See Diethyl dithiocarbonate  
 Carophyllic acid  
   See Eugenol  
 Carvene  
   See *d*-Limonene  
 Carvol  
   See *d*-Carvone  
 Cetane  
   See Hexadecane  
 Cetene  
   See 1-Hexadecene  
 Cetylene  
   See 2-Hexadecyne  
 Cetyl mercaptan  
   See 1-Hexadecanethiol  
 Chaulmestrol  
   See Ethyl chaulmoograte  
 Chinaldine  
   See Quinaldine  
 Chinoline  
   See Quinoline  
 Chloral diethyl acetal  
   See 1,1,1-Trichloro-2,2-diethoxyethane  
 Chloroacetic acid  
   See Dichloroacetic acid  
 Chloroacetone  
   See Chloro-2-propanone  
 Chloroallyl alcohol  
   See Chloropropen-1-ol  
*a*-Chloroallyl chloride  
   See 2,3-Dichloro-1-propene  
 Chloroallylene  
   See 3-Chloropropyne  
 Chlorobenzol  
   See *a,a*-Dichlorotoluene  
 Chlorobenzene  
   See Chlorobenzaldehyde  
 Chlorobenzol  
   See Chlorobenzene  
 2-Chloro-1,3-butadiene  
   See Chloroprene  
 1-Chloro-2-( $\beta$ -chloroethoxy)-ethane  
   See Bis-(2-chloroethyl) ether  
 1-Chloro-2-( $\beta$ -chloroethyl thio) ethane  
   See Bis-(2-chloroethyl) sulfide  
 Chloro (chloromethoxy) methane  
   See Bis-(chloromethyl) ether  
 2-Chloro-1,1-diethoxyethane  
   See Chloroacetal  
 $\beta$ -Chlorodiethyl ether  
   See  $\beta$ -Chloroethyl ethyl ether  
 Chlorodimethylarsine  
   See Cacodyl chloride  
 1-Chloro-2,3-epoxypropane  
   See Epichlorohydrin  
 2-Chloroethanol  
   See 2-Chloro-1-ethanol  
 2-Chloroethanal  
   See Chloroacetaldehyde  
 Chloroethanoyl chloride  
   See Chloroacetyl chloride  
 Chloroethoxybenzene  
   See Chlorophenetole  
 1-Chloro-2-ethoxyethane  
   See  $\beta$ -Chloroethyl ethyl ether  
 2 or  $\beta$ -Chloroethyl alcohol  
   See 2-Chloro-1-ethanol  
 Chlorohydrin  
   See Chloropropanediol  
 Chlorohydroxybenzene  
   See Chlorophenol  
 Chlorohydroxy diethyl ether  
   See 2-(2-Chloroethoxy) ethanol  
 $\gamma$ -Chloroisobutylene  
   See 3-Chloro-2-methylpropene  
 Chloroisopropyl alcohol  
   See 1-Chloro-2-propanol  
 Chloromethylbenzene  
   See Chlorotoluene  
 Chloromethyl cyanide  
   See Chloroacetonitrile  
 Chloromethyl ethyl ketone  
   See 1-Chloro-2-butanone  
 (Chloromethyl)oxirane  
   See Epichlorohydrin  
*a*-Chloronaphthalene  
   See 1-Chloronaphthalene  
 Chlorooctane  
   See Octyl chloride  
 Chlorophenylamine  
   See Chloroaniline

Chlorophenylethylene  
See Chlorostyrene  
Chlorophenyl ethyl ether  
See Chlorophenetole  
2-Chloropropanoic acid  
See  $\alpha$ -Chloropropionic acid  
 $\beta$ -Chloropropyl alcohol  
See 2-Chloro-1-propanol  
Chloropropylene  
See Chloropropene  
2-Chloropropylene oxide  
See Epichlorohydrin  
 $\alpha$ -Chlorotoluol  
See  $\alpha$ -Chlorotoluene  
Chlorpiperin  
See Chloropicrin  
Chlorovinylarsine dichloride  
See Lewisite  
Chlorylene  
See 1,1,2-Trichloroethylene  
Cincholepidine  
See Lepidine  
Cinene  
See Dipentene  
Cinnamal  
See Cinnemaldehyde  
Cinnamene  
See Styrene  
Cinnamenol  
See Styrene  
Cinnamic aldehyde  
See Cinnamaldehyde  
Cinnamol  
See Styrene  
Cinnamylaldehyde  
See Cinnamaldehyde  
Citrene  
See d-Limonene  
Citronellyl acetic ether  
See Citronellyl acetate  
Citrylidene acetone  
See Pseudoionone  
Clairsite  
See Trichloromethanethiol  
Coal tar naphtha  
See Naphtha (Solvent)  
Cognac oil  
See Ethyl enanthate  
Cologne spirit  
See Ethyl alcohol  
Colonial spirits  
See Methanol  
Columbian spirits  
See Methanol  
Columnian spirits  
See Methanol  
 $\alpha$ -Coniceine  
See Piperolidine

Conyrrine  
See 2-Propylpyridine  
Coriandrol  
See d-Linalool  
Coumarone  
See 3(2)-Benzofuran  
Cresatin  
See m-Toluy acetate  
Cresyl acetate  
See Toluy acetate  
Cresyl benzoate  
See Toluy benzoate  
Cresyl ethyl ether  
See Ethyl tolyl ether  
Cresylic acid  
See Cresol  
Cresyl methyl ether  
See Methyl tolyl ether  
Crotonic aldehyde  
See Crotonaldehyde  
Crotonyl acetate  
See 2-Butenyl acetate  
Crotonyl alcohol  
See 2-Buten-1-ol  
Crotonyl chloride  
See 1-Chloro-2-butene  
Crotonylene  
See 2-Butyne  
Crotonyl iodide  
See 1-Iodo-2-butene  
Crotyl acetate  
See 2-Butenyl acetate  
Crotyl alcohol  
See 2-Buten-1-ol  
Crotyl chloride  
See 1-Chloro-2-butene  
Crude Oil  
See Petroleum  
o-Cumenol  
See o-Isopropylphenol  
p-Cumic alcohol  
See Cuminy alcohol  
p-Cuminic alcohol  
See Cuminy alcohol  
p-Cuminic aldehyde  
See Cumaldehyde  
Cuminy alcohol  
See 1-Chlorocymene  
Cumol  
See Cumene  
Cumol  
See Cuminy alcohol  
Cyanobenzene  
See Benzonitrile  
Cyanodiethylamine  
See Diethylcyanamide  
 $\alpha$ -Cyanoethyl acetate  
See Lactonitrile acetate

Cyanoethyl carbonate  
See Ethyl cyanoformate  
2-Cyanofuran  
See Furylnitrile  
Cyanomethyl carbonate  
See Methyl cyanoformate  
3-Cyanopentane  
See  $\alpha$ -Ethylbutyronitrile  
2-Cyanopropanoic acid  
See Cyanopropionic acid  
2-Cyclohexanol cyclohexanol  
See 2-Cyclohexylcyclohexanol  
Cyclohexatriene  
See Benzene  
Cyclohexylbenzene  
See Phenylcyclohexane  
Cyclohexyl bromide  
See Bromocyclohexane  
Cyclohexyl chloride  
See Chlorocyclohexane  
Cyclohexyl iodide  
See Iodocyclohexane  
Cyclohexylmethane  
See Methylcyclohexane  
Cymidine  
See Carvacrylamine  
Cymophenol  
See Carvacrol  
2-p-Cymylamine  
See Carvacrylamine  
 $\beta$ -Cytisolidine  
See 6,8-Dimethylquinoline  
DCB  
See 1,3-Dichloro-2-butene  
Decahydrobiphenyl  
See Bicyclohexyl  
Decahydrodiphenyl  
See Bicyclohexyl  
Decahydronaphthalene  
See cis-Decalin  
Decanol  
See Capraldehyde  
Decanenitrile  
See Caprinitrile  
Decanoic anhydride  
See Capric anhydride  
1-Decanol nit-ate  
See Decyl nitrate  
1-Decanol nitrite  
See Decyl nitrite  
Decanoyl chloride  
See Capryl chloride  
Decyl alcohol  
See Decanol  
Decyl aldehyde  
See Capraldehyde

- Decyl carbinol  
   See Hendecyl alcohol  
 Decyl chloride  
   See 1-Chlorodecane  
 Decyl cyanide  
   See Hendecanenitrile  
 $\alpha$  or n-Decylene  
   See 1-Decene  
 Decylene  
   See 5-Ethyl-2-methyl-5-heptene  
 Decylene  
   See 3,3,5-Trimethyl-4-Heptene  
 Decyl hydride  
   See Decane  
 Decylic anhydride  
   See Capric anhydride  
 Decyl iodide  
   See 1-Iododecane  
 Decyl mercaptan  
   See 1-Decanethiol  
 Decylmethylacetylene  
   See 2-Dodecyne  
 Dekalin  
   See Decalin  
 dl-Desoxynorephedrine  
   See Benzedrine  
 Diacetoethyl acetate  
   See Ethyl diacetoacetate  
 Diacetone  
   See Diacetone alcohol  
 Diacetonyl alcohol  
   See Diacetone alcohol  
 Diacetyl  
   See Biacetyl  
 1,2- or sym-Diacetylene  
   See 2,5-Hexanedione  
 Diacetylmethane  
   See 2,4-Pentanedione  
 Diallyl  
   See Biallyl  
 1,3-Diaminobutane  
   See 1,3-Butanediamine  
 2,2'-Diaminodiethylamine  
   See Diethylenetriamine  
 1,2-Diaminoethane  
   See Ethylenediamine  
 1,2-Diaminopropane  
   See dl-1,2-Propanediamine  
 3,5-Diaminotoluene  
   See 5-m-Tolylenediamine  
 Di-n-amy lacetylene  
   See 6-Dodecyne  
 Diamyl alcohol  
   See 3-Isopropyl-5-methyl-1-hexanol  
 Diamyldiphenyl  
   See Diamylbiphenyl  
 Diamyl ketone  
   See 6-Hendecanone  
 Diarsenic tetramethyl  
   See Cacodyl  
 Diatol  
   See Ethyl carbonate  
 Diazine  
   See Pyrimidine  
 1,2-Diazine  
   See Pyridazine  
 Diazoethyl acetate  
   See Ethyl diazoacetate  
 1,2-Dibromoethene  
   See 1,2-Dibromoethylene  
 Dibromoethyne  
   See Dibromoacetylene  
 1-Dibromohydrin  
   See 1,3-Dibromo-2-propanol  
 Dibromoisobutane  
   See 1,1-Dibromo-2-methylpropane  
 $\alpha, \gamma$ -Dibromopropylene  
   See 1,3-Dibromopropene  
 Dibutylacetylene  
   See 5-Decyne  
 Dibutoxy ethyl phthalate  
   See Butyl "Cellosolve" phthalate  
 Dibutyl 1,2-benzenedicarboxylate  
   See Dibutyl phthalate  
 Dibutylcarbinol  
   See 5-Nonanol  
 Dibutyl ethanedioate  
   See Butyl oxalate  
 Dibutyl ketone  
   See 5-Nonanone  
 Dicaproate  
   See Triethylene glycol  
 uns-Dichloroacetone  
   See 1,1-Dichloro-2-propanone  
 Dichloroaldehyde  
   See Dichloroacetaldehyde  
 Dichlorobenzol  
   See Dichlorobenzene  
 tert-Dichlorobutyl alcohol  
   See 1,3-Dichloro-2-methyl-2-propanol  
 Dichloro(2-chlorovinyl)arsine  
   See Lewisite  
 1,1-Dichloro-2,2-diethoxyethane  
   See Dichloroacetal  
 $\beta, \beta'$ -Dichlorodiethyl carbonate  
   See Bis(2-Chloroethyl) carbonate  
 $\alpha, 2'$  or  $\beta, \beta'$ -Dichlorodiethyl sulfide  
   See Bis-(2-chloroethyl) sulfide  
 $\beta, \beta'$ -Dichlorodiisopropyl ether  
   See Bis-( $\beta$ -Chloroisopropyl) ether  
 sym-Dichlorodimethyl ether  
   See Bis-(chloromethyl) ether  
 x-Dichlorodiphenyl ether  
   See Bis-(x-chlorophenyl) ether  
 $\gamma, \gamma'$ -Dichlorodipropyl ether  
   See Bis-(3-chloropropyl) ether  
 2,2-Dichloroethanal  
   See Dichloroacetaldehyde  
 Dichloroethanal  
   See Dichloroacetaldehyde  
 Dichloroethanoic acid  
   See Dichloroacetic acid  
 Dichloro-1-ethanol  
   See Dichloroethyl alcohol  
 Dichloroethanoyl chloride  
   See Dichloroacetyl chloride  
 Dichloroethene  
   See Dichloroethylene  
 Dichloroether  
   See 1,2-Dichloroethyl ethyl ether  
 1,2-Dichloro-1-ethoxyethane  
   See 1,2-Dichloroethyl ethyl ether  
 $\alpha, \beta$ -Dichloroethyl ether  
   See 1,2-Dichloroethyl ethyl ether  
 $\beta, \beta'$ -Dichloroethyl ether  
   See Bis(2-chloroethyl) ether  
 2,2'-Dichloroethyl formal  
   See Bis-(2-chloroethyl) formal  
 $\alpha$ -Dichlorohydrin  
   See 1,3-Dichloro-2-propanol  
 Dichloroisobutane  
   See Dichloro-2-methylpropanes  
 sym-or 1,3-Dichloroisopropyl alcohol  
   See 1,3-Dichloro-2-propanol  
 Dichloroisopropyl ether  
   See Bis-( $\beta$ -chloroisopropyl) ether

- sym-Dichloromethyl ether  
 See Bis-(chloromethyl) ether  
 Dichloromethyl methyl ketone  
 See Dichloroacetone  
 Dichloropentane  
 See Dichloromethylbutanes  
 1,3-Dichloropropane-2-ol  
 See 1,3-Dichloro-2-propanol  
 Dichloropropylene  
 See Dichloro-1-propene  
 Dichloropropyl nitrate  
 See Dichloronitrohydrin  
 Dicyclohexyl  
 See Bicyclohexyl  
 1,1-Diethoxyethane  
 See Acetal  
 Diethoxyethane  
 See Diethyl "Cellosolve"  
 Diethoxyethyl carbonate  
 See "Cellosolve" carbonate  
 Diethoxyethyl maleate  
 See "Cellosolve" maleate  
 Diethoxyethyl phthalate  
 See "Cellosolve" phthalate  
 Diethoxyethyl ricinoleate  
 See "Cellosolve" ricinoleate  
 Diethoxyethyl sebacate  
 See "Cellosolve" sebacate  
 Diethoxyethyl stearate  
 See "Cellosolve" stearate  
 Diethoxymethane  
 See Diethylformal  
 Diethoxy-(2-propenyl) propanedioate  
 See Diethyl allylmalonate  
 Diethylacetal  
 See Acetal  
 Diethylacetaldehyde  
 See  $\alpha$ -Ethylbutyraldehyde  
 Diethylacetic acid  
 See 2-Ethylbutyric acid  
 Diethylacetoneitrile  
 See  $\alpha$ -Ethylbutyronitrile  
 Diethyl acetylbutanedioate  
 See Diethyl acetyl-succinate  
 Diethylacetylene  
 See 3-Hexyne  
 Diethylaldehyde  
 See Acetal  
 $\beta$ -Diethylaminoethyl alcohol  
 See 2-Diethylaminoethanol  
 $\alpha$ -Diethylamino-2,3-propanediol  
 See 1-Diethylaminoglycerol  
 Diethyl benzylpropanedioate  
 See Diethylbenzylmalonate  
 Diethyl bromopropanedioate  
 See Diethyl bromomalonate  
 Diethyl 3-butene-1,1-dicarboxylate  
 See Diethyl allylmalonate  
 Diethylcarbinol  
 See 3-Pentanol  
 Diethyl carbinol  
 See sec-n-Amyl alcohol  
 Diethylcarbinol acetate  
 See sec-Amyl acetate  
 Diethyl 2,3-diacetylbutanedioate  
 See Diethyl diacetosuccinate  
 Diethyl diethylpropanedioate  
 See Diethyl diethylmalonate  
 Diethyl d-2,3-dihydroxybutanedioate  
 See Ethyl d-tartrate  
 Diethyldimethylmethane  
 See 3,3-Dimethylpentane  
 Diethyl dimethylpropanedioate  
 See Diethyl dimethylmalonate  
 Diethyl 1,3-diphenyl-2,2-propanedicarboxylate  
 See Diethyl dibenzylmalonate  
 Diethylene dioxide  
 See p-Dioxane  
 Diethylene ether  
 See p-Dioxane  
 Diethylene glycol diethyl ether  
 See Diethyl "Carbitol"  
 Diethylene glycol monobenzyl ether  
 See Benzyl "Carbitol"  
 Diethylene glycol monobutyl ether  
 See Butyl "Carbitol"  
 Diethylene glycol monobutyl ether acetate  
 See Butyl "Carbitol" acetate  
 Diethylene glycol monoethyl ether  
 See "Carbitol"  
 Diethylene glycol monoethyl ether acetate  
 See "Carbitol" acetate  
 Diethylene glycol monomethyl ether  
 See Methyl "Carbitol"  
 Diethylene glycol monomethyl ether acetate  
 See Methyl "Carbitol" acetate  
 Diethylene imide  
 See Morpholine  
 Diethyleneimide oxide ethanol  
 See 4-Morpholineethanol  
 Diethylene oxide  
 See p-Dioxane  
 Diethylene oxide 2-iminoethyl alcohol  
 See 4-Morpholineethanol  
 Diethyl ethanedioate  
 See Ethyl oxalate  
 Diethyl ether  
 See Ethyl ether  
sym-Diethylethylene  
 See 3-Hexene  
 Diethylhexylamine  
 See Dioctylamine  
 Diethyl hydrogen phosphate  
 See Diethyl phosphoric acid  
 Diethyl hydroxybutanedioate  
 See Ethyl malate  
 Diethyl hydroxybutenedioate  
 See Diethyl oxalacetate  
 Diethylisobutylcarbinol  
 See 3-Ethyl-5-methyl-3-hexanol  
 Diethylisobutylmethanol  
 See 3-Ethyl-5-methyl-3-hexanol  
 Diethylisopropylcarbinol  
 See 3-Ethyl-2-methyl-3-pentanol  
 Diethylisopropylmethane  
 See 3-Ethyl-2-methylpentane  
 Diethyl ketomalonate  
 See Ethyl mesoxalate  
 Diethyl ketone  
 See 3-Pentanone  
 1,3-Diethyl-5-methylbenzene  
 See 3,5-Diethyltoluene  
 Diethylmethylcarbinol  
 See 3-Methyl-3-pentanol acetate  
 1,1-Diethyl-2-methylethylene  
 See 3-Ethyl-2-pentene  
 Diethylmethylmethane  
 See 3-Methylpentane  
 Diethyl monoselenide  
 See Ethyl selenide  
 Diethylolamine  
 See Diethanolamine  
 Diethyl oxide  
 See Ethyl ether  
 Diethyl oxopropanedioate  
 See Ethyl mesoxalate  
 Diethyl pentanedioate  
 See Ethyl glutarate

$\beta,\beta$ -Dihydroxydiethylamine  
 See Diethanolamine  
 2,2'- or  $\beta,\beta'$ -Dihydroxydiethyl ether  
 See Diethylene glycol  
 $\beta,\beta'$ -Dihydroxydiethyl sulfide  
 See 2,2'-Thiodiethanol  
 $\beta,\beta'$ -Dihydroxydi-n-propyl ether  
 See Dipropylene glycol  
 Di-2-hydroxyethylamine  
 See Diethanolamine  
 Di-2-hydroxyethyl ether  
 See Diethylene glycol  
 Di-2-Hydroxyethyl sulfide  
 See 2,2'-Thiodiethanol  
 1,2-Dihydroxypropane  
 See 1,2-Propanediol  
 2,3-Dihydroxypropanoic acid  
 See dl-Glyceric acid  
 Dihydroxypropionic acid  
 See dl-Glyceric acid  
 Diisobutyl  
 See 2,5-Dimethylhexane  
 Diisobutylcarbinol  
 See 2,6-Dimethyl-4-heptanol  
 Diisoamyl  
 See 2,7-Dimethyloctane  
 Diisobutyl ketone  
 See 2,6-Dimethyl-4-heptanone  
 Diisobutylmethane  
 See 2,6-Dimethylheptane  
 Diisobutylmethanol  
 See 2,6-Dimethyl-4-heptanol  
 Diisocrotyl  
 See 2,5-Dimethyl-2,4-hexadiene  
 Diisopropenyl  
 See 2,3-Dimethyl-1,3-butadiene  
 Diisopropyl  
 See 2,3-Dimethylbutane  
 s-Diisopropylacetone  
 See 2,6-Dimethyl-4-heptanone  
 Diisopropylcarbinol  
 See 2,4-Dimethyl-3-pentanol  
 Diisopropylidenehydrazine  
 See Acetone azine  
 Diisopropyl ketone  
 See 2,4-Dimethyl-3-pentanone  
 Diisopropylmethane  
 See 2,4-Dimethylpentane

Diisopropylmethanol  
See 2,4-Dimethyl-3-pentanol

Diketobutane  
See Biacetyl

2,5-Diketohehexane  
See 2,5-Hexanedione

Dimethoxyethane  
See Glycol dimethyl ether

Dimethoxy ethyl adipate  
See Dimethyl "Cellosolve" adipate

Dimethoxy ethyl carbonate  
See Dimethyl "Cellosolve" carbonate

Dimethoxy ethyl phthalate  
See Dimethyl "Cellosolve" phthalate

Dimethoxymethane  
See Methylal

Dimethoxytetraethylene glycol  
See Tetraethylene glycol dimethyl ether

Dimethoxytetraglycol  
See Tetraethylene glycol dimethyl ether

Dimethylacetic acid  
See Isobutyric acid

sym-Dimethylacetone  
See 3-Pentanone

Dimethylacetylene  
See 2-Butyne

$\alpha, \beta$ -Dimethylacrolein  
See Tiglaldehyde

trans-Dimethylacrylic aldehyde  
See Tiglaldehyde

Dimethyl aldehyde  
See 1,1-Dimethoxyethane

unsym-Dimethylallene  
See 3-Methyl-1,2-butadiene

$\alpha$ -Dimethylaminoglycerol  
See Dimethylamino-1,2-propanediol

$\gamma$ -Dimethylaminopropylene glycol  
See Dimethylamino-1,2-propanediol

Dimethylaniline  
See Xylidine

Dimethylarsenic monochloride  
See Cacodyl chloride

Dimethylbenzene  
See Xylene

Dimethyl 1,2-benzenedicarboxylate  
See Dimethyl phthalate

Dimethyl benzyl carbinol  
See Benzyl dimethyl  
methanol

Dimethylbiphenyl  
See Bitolyl

Dimethyl butanedioate  
See Methyl succinate

2,3-Dimethyl-2,3-butanediol  
acetate  
See Pinacolyl acetate

Dimethylbutanoic acid  
See Dimethylbutyric acid

3,3-Dimethyl-2-butanol  
See Pinacolyl alcohol

3,3-Dimethyl-2-butanone  
See Pinacolone

$\alpha,\gamma$ -Dimethylbutyl acetate  
See 4-Methyl-2-pentanol  
acetate

Dimethylcarbinol  
See Isopropyl alcohol

Dimethyl carbinol  
See tert-Amyl alcohol

Dimethyl chlorarsine  
See Cacodyl chloride

Dimethylcyclohexadiene  
See Dihydroylene

Dimethyldiketone  
See Biacetyl

Dimethylethanolamine  
See Dimethylaminoethanol

Dimethylethylacetic acid  
See Dimethylbutyric acid

Dimethylethylcarbinol  
See tert-Amyl alcohol

Dimethylethylcarbinylamine  
See tert-Amylamine

Dimethylethyl compounds  
See tert-Butyl compounds

Dimethylethylene glycol  
See 2-Methyl-1,2-  
propanediol

sym-Dimethylethylene glycol  
See 2,3-Butanediol

Dimethylethylphenylmethane  
See tert-Amyl benzene

Dimethyl glycol phthalate  
See Dimethyl "Celliosolve"  
phthalate

Dimethylhexylcarbinol  
See 2-Methyl-2-octanol

Dimethylisopropylmethane  
See 2,3-Dimethylbutane

Dimethylketazine  
See Acetone azine

Dimethyl ketal  
See Acetone

Dimethyl ketone  
See Acetone

Dimethylnitrosamine  
See N-Nitrosodimethylamine

Dimethylphenylamine  
See Dimethylaniline

Dimethylphenylenediamine  
See Aminodimethylaniline

Dimethylphenylmethane  
See tert-Amylbenzene

2,2-Dimethylpropanal  
See Pivalaldehyde

Dimethyl propanedioate  
See Methyl malonate

2,2-Dimethylpropanenitrile  
See  $\alpha,\alpha$ -Dimethylpropio  
nitrile

Dimethylpropenylcarbinol  
See 3-Penten-2-ol

( $\alpha,\alpha$ -Dimethylpropyl)amine  
See tert-Amylamine

Dimethylpropylcarbinol  
See 2-Methyl-2-pentanol

Dimethylpropylmethane  
See 2-Methylpentane

Dimethylpyridine  
See Lutidine

Dioxyethylene ether  
See p-Dioxane

Dipentene  
See dl-Limonene

Dipentine  
See Dipentene

Dipentyl ketone  
See 6-Hendecanone

Dipropargyl  
See 1,5-Hexadiyne

Dipropenyl  
See 2,4-Hexadiene

Di-2-propenylamine  
See Diallylamine

Dipropylacetic acid  
See Propylvaleric acid

Dipropylacetylene  
See 4-Octyne

Dipropylcarbinol  
See 4-Heptanol

Dipropylene  
See 2,4-Hexadiene

Dipropyl ketone  
See Butyrone

Dipropylmethane  
See Heptane

Dipropylnitrosamine  
See N-Nitrosodipropyl-  
amine

Dipropyl propanedioate  
See Propyl malonate

Ditan  
See Diphenylmethane

Titolyl  
See Bitolyl

Divinylacetylene  
See 1,5-Hexadien-3-yne

Dodecane  
See 2,4,5,7-Tetramethyl-  
octane

Dodecanenitrile  
See Lauronitrile

Dodecanoyl chloride  
See Lauroyl chloride

Dodecyl bromide  
See 1-Bromododecane

Dodecyl chloride  
See 1-Chlorododecane

$\alpha$ -Dodecylene  
See 1-Dodecene

n-Dodecyl mercaptan  
See 1-Dodecanethiol

Dutch liquid  
See 1,2-Dichloroethane

Earth oil  
See Petroleum

Eglantine  
See Isobutyl  $\alpha$ -Toluate

Elchem 880  
See Dihydropyran

Enanthal  
See Enanthaldehyde

Enanthole  
See Enanthaldehyde

Enanthylic acid  
See Enanthic acid

Enanthylidene  
See 1-Heptyne

$\alpha$ -Epichlorohydrin  
See 2,3-Dichloro-1-propen

$\alpha$ -Epidibromohydrin  
See 2,3-Dibromopropylene

$\beta$ -Epidibromohydrin  
See 1,3-Dibromopropene

$\beta$ -Epidichlorohydrin  
See 1,3-Dichloro-1-propen

Epihydric alcohol  
See Glycidol

Epihydrin alcohol  
See Glycidol

1,2-Epoxyethane  
See Ethylene oxide

1,2-Epoxy-2-iodopropane  
See Epiiodohydrin

Epoxymenthane  
See Cineole

5,8-Epoxy-1-p-menthene  
 See dl-Pinol  
 2-Epoxy-2-methylpropane  
 See d,d-Dimethylethylene  
 oxide  
 2-Epoxypropane  
 See Propylene oxide  
 2,3-Epoxy-1-propanol  
 See Glycidol  
 Ethanal  
 See Acetaldehyde  
 Ethanedial  
 See Glyoxal  
 2-Ethanediamine  
 See Ethylenediamine  
 2-Ethanediol  
 See Glycol  
 Ethanedioyl chloride  
 See Oxalyl chloride  
 Ethanethiolic acid  
 See Thiolacetic acid  
 Ethanoic acid  
 See Acetic acid  
 Ethanol  
 See Ethyl alcohol  
 Ethanolamine  
 See 2-Aminoethanol  
 Ethanol-1-thiol-2  
 See 2-Mercaptoethanol  
 Ethanoyl bromide  
 See Acetyl bromide  
 Ethanoyl chloride  
 See Acetyl chloride  
 Ethanoyl fluoride  
 See Acetyl fluoride  
 Ethanoyl iodide  
 See Acetyl iodide  
 Ethoxyethane  
 See Ethyl vinyl ether  
 Ethenylamine  
 See Vinylamine  
 Ethenyloxyethene  
 See Vinyl ether  
 Ethenylthioethene  
 See Vinyl sulfide  
 Ethenyl triethyl ether  
 See Ethyl orthoacetate  
 Ether  
 See Ethyl ether  
 Ethinyl carbinol  
 See 2-Propyn-1-ol  
 Ethinyl tribromide  
 See 1,1,2-Tribromoethylene  
 Ethinyl trichloride  
 See 1,1,2-Trichloro-  
 ethylene  
 Ethox"  
 See "Cellosolve" phthalate

Ethoxyamine  
 See Ethyl  $\alpha$ -hydroxylamine  
 Ethoxyaniline  
 See Phenetidine  
 Ethoxybenzene  
 See Phenetole  
 1-Ethoxybutane  
 See Butyl ethyl ether  
 Ethoxydiglycol phthalate  
 See "Carbitol" phthalate  
 Ethoxyethane  
 See Ethyl ether  
 Ethoxyethanoic acid  
 See Ethoxyacetic acid  
 2-Ethoxyethanol  
 See "Cellosolve"  
 2-Ethoxyethanol acetate  
 See "Cellosolve" acetate  
 2-( $\beta$ -Ethoxyethoxy)ethanol  
 See "Carbitol"  
 1-Ethoxy-2-( $\beta$ -ethoxyethoxy)  
 ethane  
 See Diethyl "Carbitol"  
 Ethoxythoxy glycol phthalate  
 See "Cellosolve" phthalate  
 Ethoxylaniline  
 See 2-Anilinoethanol  
 $\beta$ -Ethoxylethyl acetate  
 See "Cellosolve" acetate  
 Ethoxypiperidine  
 See Piperidineethanol  
 1-Ethoxyhexane  
 See Ethyl hexyl ether  
 1-Ethoxy-3-methylbutane  
 See Ethyl isoamyl ether  
 1-Ethoxy-2-methylpropane  
 See Ethyl isobutyl ether  
 2-Ethoxy-2-methylpropane  
 See tert-Butyl ethyl ether  
 1-Ethoxynaphthalene  
 See Ethyl 1-naphthyl ether  
 1-Ethoxyoctane  
 See Ethyl octyl ether  
 1-Ethoxypentane  
 See Amyl ethyl ether  
 1-Ethoxypropane  
 See Ethyl propyl ether  
 2-Ethoxypropane  
 See Ethyl isopropyl ether  
 3-Ethoxypropene  
 See Allyl ethyl ether  
 3-Ethoxypropyne  
 See Ethyl propargyl ether  
 $\alpha$ -Ethoxytoluene  
 See Benzyl ethyl ether  
 Ethoxytoluene  
 See Ethyl tolyl ether

Ethylacetic acid  
 See Butyric acid  
 Ethyl  $\alpha$ -acetylacetoacetate  
 See Ethyl diacetoacetate  
 Ethylacetylene  
 See 1-Butyne  
 Ethyl acetylmalonate  
 See Diethyl acetylmalonate  
 Ethyl 2-acetyl-3-oxobutanoate  
 See Ethyl diacetoacetate  
 Ethyl acetyl succinate  
 See Diethyl acetylsuccinate  
 $\beta$ -Ethylacrylic acid  
 See 2-Pentenoic acid  
 Ethylal  
 See Diethylformal  
 Ethylalbenzene  
 See  $\alpha$ -Tolualdehyde  
 Ethyl aldehyde  
 See Acetaldehyde  
 Ethylallene  
 See 1,2-Pentadiene  
 Ethyl allylmalonate  
 See Diethyl allylmalonate  
 Ethyl o-aminobenzoate  
 See Ethyl anthranilate  
 Ethyl aminoethanoate  
 See Ethyl glycinate  
 2-Ethyl-1-aminoethane  
 See 2-Ethyl-1-hexylamine  
 Ethyl act-amyl ether  
 See Ethyl 2-methylbutyl  
 ether  
 Ethyl amylmalonate  
 See Diethyl amylmalonate  
 Ethyl benzenecarboxylate  
 See Ethyl benzoate  
 Ethyl benzenepropanoate  
 See Ethyl hydrocinnamate  
 Ethylbenzol  
 See Ethylbenzene  
 Ethyl benzyl ketone  
 See 1-Phenyl-2-butanone  
 Ethyl benzylmalonate  
 See Diethyl benzylmalonate  
 Ethyl borate  
 See Triethyl borate  
 Ethyl bromide  
 See Bromoethane  
 Ethyl 2-bromobutanoate  
 See Ethyl  $\alpha$ -bromobutyrate  
 Ethyl bromoethanoate  
 See Ethyl bromoacetate  
 Ethyl bromomalonate  
 See Diethyl bromomalonate  
 Ethyl 2-bromopentanoate  
 See Ethyl  $\alpha$ -bromovalerate

Ethyl 2-bromopropanoate  
   See Ethyl  $\alpha$ -bromopropionate  
 Ethyl 2-bromo-2-methylpropanoate  
   See Ethyl  $\alpha$ -bromoisobutyrate  
 Ethyl 1,1-butanedicarboxylate  
   See Diethyl propylmalonate  
 2-Ethylbutanenitrile  
   See  $\alpha$ -Ethylbutyronitrile  
 Ethyl butanoate  
   See Ethyl butyrate  
 2-Ethylbutanoic acid  
   See 2-Ethylbutyric acid  
 2-Ethylbutyl alcohol  
   See 2-Ethyl-1-butanol  
 Ethyl-N-butylcarbamate  
   See  $\bar{N}$ -Butylurethane  
 Ethyl  $\bar{n}$ -butyl ketone  
   See 3-Heptanone  
 Ethyl  $\bar{n}$ -butylmalonate  
   See Diethyl butylmalonate  
 Ethyl *sec*-butylmalonate  
   See Diethyl *sec*-butylmalonate  
 2(2-Ethylbutoxy) ethanol  
   See 2-Ethylbutyl "Cellosolve"  
 Ethyl capronate  
   See Ethyl caproate  
 Ethyl carbinol  
   See Propyl alcohol  
 Ethylcarbonic acid  
   See Propionic acid  
 Ethyl Cellosolve  
   See Cellosolve  
 Ethyl chloride  
   See Chloroethane  
 Ethyl chloroethanoate  
   See Ethyl chloroacetate  
 Ethyl 2-chloro-3-oxobutanoate  
   See Ethyl  $\alpha$ -chloroacetoacetate  
 Ethyl 4-chloro-3-oxobutanoate  
   See Ethyl  $\gamma$ -chloroacetoacetate  
 Ethyl chloropropanoate  
   See Ethyl chloropropionate  
 Ethyl chlorosulfate  
   See Ethyl chlorosulfonate  
 Ethyl citrate  
   See Triethyl citrate  
 Ethyl cresyl ether  
   See Ethyl tolyl ether  
 Ethyl *p*-cresyl sulfide  
   See Ethyl *p*-tolyl sulfide

Ethyl cyanide  
   See Propionitrile  
 Ethyl cyanomethanoate  
   See Ethyl cyanoformate  
 Ethyl decanoate  
   See Ethyl caprate  
 Ethyl  $\alpha, \beta$ -diacetylsuccinate  
   See Diethyl diacetosuccinate  
 Ethyl diazoethanoate  
   See Ethyl diazoacetate  
 Ethyl dibromoethanoate  
   See Ethyl dibromoacetate  
 Ethyl dichloroethanoate  
   See Ethyl dichloroacetate  
 Ethyl 2,2-diethyl-3-oxobutanoate  
   See Diethyl acetoacetate  
 Ethyl 2,3-dihydroxypropanoate  
   See Ethyl glycerate  
 Ethyldimethylacetic acid  
   See  $\alpha, \alpha$ -Dimethylbutyric acid  
 Ethyldimethylbenzene  
   See Ethylxylene  
 Ethyldimethylethylene  
   See Methylpentene  
 Ethyldimethylmethane  
   See 2-Methylbutane  
 2-Ethyl-3,5-dimethylpyridine  
   See  $\alpha$ -Parvoline  
 Ethyldipropylcarbinol  
   See 4-Ethyl-4-heptanol  
 Ethyldipropylmethane  
   See 4-Ethylheptane  
 Ethyldipropylmethanol  
   See 4-Ethyl-4-heptanol  
 Ethyl dithiolcarbonate  
   See Diethyl dithiocarbonate  
 Ethyleneacetic acid  
   See Cyclopropanecarboxylic acid  
 Ethylene alcohol  
   See Glycol  
 Ethylene bromide  
   See 1,2-Dibromoethane  
 Ethylene bromohydrin  
   See 2-Bromo-1-ethanol  
 Ethylene butyrate  
   See 1,2-Ethanediol dibutyrate  
 Ethylene caprylate  
   See 1,2-Ethanediol dicaprylate  
 Ethylenecarboxylic acid  
   See Acrylic acid  
 Ethylene chloride  
   See 1,2-Dichloroethane

Ethylene chlorobromide  
   See 1,2-Bromochloroethane  
 Ethylene chlorohydrin  
   See 2-Chloro-1-ethanol  
 Ethylene cyanohydrin  
   See Hydracrylonitrile  
 Ethylene dibromide  
   See 1,2-Dibromoethane  
 Ethylene dichloride  
   See 1,2-Dichloroethane  
 2,2'-Ethylenedioxydiethanol  
   See Triethylene glycol  
 Ethylene dipropionate  
   See Ethylene glycol dipropionate  
 Ethylene ethylidene ether  
   See Methyl dihydroabietate  
 Ethylene ethylidene oxide  
   2-Methyl-1,3-dioxolane  
 Ethylene fluorohydrin  
   See 2-Fluoroethanol  
 Ethylene formate  
   See 1,2-Ethanediol diformate  
 Ethylene glycol  
   See Glycol  
 Ethylene glycol diacetate  
   See 1,2-Ethanediol diacetate  
 Ethylene glycol dibutyrate  
   See 1,2-Ethanediol dibutyrate  
 Ethylene glycol dicaprylate  
   See 1,2-Ethanediol dicaprylate  
 Ethylene glycol diethyl ether  
   See Diethyl "Cellosolve"  
 Ethylene glycol diformate  
   See 1,2-Ethanediol diformate  
 Ethylene glycol ethylbutyl ether  
   See 2-Ethylbutyl "Cellosolve"  
 Ethylene glycol monoacetate  
   See 1,2-Ethanediol monoacetate  
 Ethylene glycol monobenzyl ether  
   See Benzyl "Cellosolve"  
 Ethylene glycol monobutyl ether  
   See Butyl "Cellosolve"  
 Ethyleneglycol monoethyl ether  
   See "Cellosolve"

- Ethylene glycol monoethyl ether acetate  
 See "Cellosolve" acetate  
 Ethylene glycol monoformate  
 See 1,2-Ethanediol monoformate  
 Ethylene glycol monomethyl acetal  
 See Methyl "Cellosolve" acetal  
 Ethylene glycol monomethyl ether  
 See Methyl "Cellosolve"  
 Ethylene glycol monomethyl ether acetate  
 See Methyl "Cellosolve" acetate  
 Ethylene glycol monooctyl ether  
 See Octyl "Cellosolve"  
 Ethylene glycol monophenyl ether  
 See Phenyl "Cellosolve"  
 Ethylene iodohydrin  
 See 2-Iodo-1-ethanol  
 Ethylene lactic acid  
 See Hydracrylic acid  
 Ethylene monoformate  
 See 1,2-Ethanediol monoformate  
 Ethylene nitrate  
 See Ethylene glycol dinitrate  
 Ethylene nitrite  
 See Ethylene glycol dinitrite  
 Ethylene tetrachloride  
 See Tetrachloroethylene  
 Ethylene tribromide  
 See 1,1,2-Tribromoethylene  
 Ethylene trichloride  
 See 1,1,2-Trichloroethylene  
 Ethyl ethanolamine  
 See  $\beta$ -Ethylaminoethanol  
 Ethyl ethoxymethane thionolthiolate  
 See Diethyl dithiocarbonate  
 Ethyl ethylbutylmalonate  
 See Diethyl ethylbutylmalonate  
 Ethylethylene glycol  
 See 1,2-Butanediol  
 Ethyl ethylisoamylmalonate  
 See Diethyl ethylisoamylmalonate  
 Ethyl ethylisopropylmalonate  
 See Diethyl ethylisopropylmalonate  
 Ethyl ethylmalonate  
 See Diethyl ethylmalonate  
 Ethyl ethylphenylmalonate  
 See Diethyl ethylphenylmalonate  
 Ethyl glycol ether  
 See Ethyl hydroxyethyl ether  
 Ethylglycolic acid  
 See Ethoxyacetic acid  
 Ethyl heptanepropanedioate  
 See Diethyl heptylmalonate  
 Ethyl heptanoate  
 See Ethyl enanthate  
 Ethyl heptoate  
 See Ethyl enanthate  
 Ethyl heptylate  
 See Ethyl enanthate  
 Ethyl heptyl ketone  
 See 3-Decanone  
 2-Ethylhexaldehyde  
 See 2-Ethylcaproaldehyde  
 2-Ethylhexanal  
 See Ethylcaproaldehyde  
 2-Ethyl-1-hexanol acetate  
 See 2-Ethylhexyl acetate  
 2-Ethylhexyl alcohol  
 See 2-Ethyl-1-hexanol  
 Ethylhexylcarbinol  
 See 3-Nonanol  
 Ethylhexyl chloride  
 See 1-Chloro-2-ethylhexane  
 Ethylhexylene glycol  
 See 2-Ethyl-1,3-hexanediol  
 Ethyl hexyl ketone  
 See 3-Nonanone  
 Ethyl hydrosulfide  
 See Ethanethiol  
 Ethyl hydroxide  
 See Ethyl alcohol  
 Ethyl hydroxybenzoate  
 See Ethyl salicylate  
 Ethyl hydroxyethanoate  
 See Ethyl glycolate  
 Ethyl 2-hydroxypropanoate  
 See Ethyl lactate  
 Ethyl  $\alpha$ -hydroxypropionate  
 See Ethyl lactate  
 Ethylic alcohol  
 See Ethyl alcohol  
 Ethylic aldehyde  
 See Acetaldehyde  
 Ethylideneacetone  
 See 3-Penten-2-one  
 Ethylidene bromide  
 See 1,1-Dibromoethane  
 Ethylidene chloride  
 See 1,1-Dichloroethane  
 Ethylidene chlorobromide  
 See 1,1-Bromochloroethane  
 Ethylidene cyanohydrin  
 See Lactonitrile  
 Ethylidene dibromide  
 See 1,1-Dibromoethane  
 Ethylidene dichloride  
 See 1,1-Dichloroethane  
 Ethylenediethyl ether  
 See Acetal  
 Ethylidene diiodide  
 See 1,1-Diiodoethane  
 Ethylidene dimethyl ether  
 See 1,1-Dimethoxyethane  
 Ethylidene iodide  
 See 1,1-Diiodoethane  
 Ethylenelactic acid  
 See dl-Lactic acid  
 Ethyl iodide  
 See Iodoethane  
 Ethyl iodoethanoate  
 See Ethyl iodoacetate  
 Ethyl isoamyl ketone  
 See 6-Methyl-3-heptanone  
 Ethylisobutylcarbinol  
 See 5-Methyl-3-hexanol  
 Ethyl isobutyl ketone  
 See 5-Methyl-3-hexanone  
 Ethyl isobutylmalonate  
 See Diethyl isobutylmalonate  
 Ethylisobutylmethane  
 See 2-Methylhexane  
 Ethylisobutylmethylmethane  
 See 2,4-Dimethylhexane  
 Ethyl isophthalate  
 See Diethyl isophthalate  
 Ethylisopropylcarbinol  
 See 2-Methyl-3-pentanol  
 Ethyl isopropyl ketone  
 See 2-Methyl-3-pentanone  
 Ethyl isopropylmalonate  
 See Diethyl isopropylmalonate  
 Ethylisopropylmethylcarbinol  
 See 2,3-Dimethyl-3-pentanol  
 Ethylisopropylmethylmethane  
 See 2,3-Dimethylpentane  
 Ethylisopropylmethylmethanol  
 See 2,3-Dimethyl-3-pentanol  
 Ethyl  $\beta$ -ketohydrocinnamate  
 See Ethyl benzoylacetate  
 Ethyl ketomalonate  
 See Diethyl mesoxalate  
 Ethyl ketone  
 See 3-Pentanone  
 Ethyl linolate  
 See Ethyl linoleate

Ethyl mercaptan  
   See Ethanethiol  
 Ethyl 2-mercaptoethanoic acid  
   See Ethyl mercaptoacetic acid  
 Ethyl mesoxalate  
   See Diethyl mesoxalate  
 N-Ethylmethanamide  
   See N-Ethylformamide  
 Ethylmethylacetic acid  
   See  $\alpha$ -Methylbutyric acid  
 asym-Ethylmethylacetone  
   See 3-Methyl-2-pentanone  
 Ethylmethylacetylene  
   See 2-Pentyne  
 Ethyl methylacrylate  
   See Ethyl methacrylate  
 Ethylmethylbenzene  
   See Ethyltoluene  
 Ethylmethylbromomethane  
   See 2-Bromobutane  
 Ethylmethylchloromethane  
   See 2-Chlorobutane  
 unsym-Ethylmethylethylene  
   See 2-Methyl-1-butene  
 Ethylmethylethylmalonate  
   See N,N-Diethylmethylethylmalonate  
 Ethyl methyliodomethane  
   See 2-Iodobutane  
 Ethylmethyl ketone  
   See 2-Butanone  
 Ethyl methyl ketoxime  
   See 2-Butanone oxime  
 Ethylmethylmethanol  
   See sec-Butyl alcohol  
 Ethyl dodecanoate  
   See Ethyl laurate  
 Ethyl 2-methyl-3-oxobutanoate  
   See Ethyl methylacetoacetate  
 Ethyl 2-methylpropanoate  
   See Ethyl isobutyrate  
 Ethylmethylpropylcarbinol  
   See 3-Methyl-3-hexanol  
 Ethylmethylpropylmethane  
   See 3-Methylhexane  
 Ethyl nitrile  
   See Acetonitrile  
 Ethyl o-nitrophenyl ether  
   See o-Nitrophenetole  
 Ethyl nonanoate  
   See Ethyl pelargonate  
 Ethyl n-nonoate  
   See Ethyl pelargonate  
 Ethyl 1,1-octanedicarboxylate  
   See Diethyl heptylmalonate

Ethyl octylate  
   See Ethyl caprylate  
 Ethyl octyl ketone  
   See 3-Hendecanone  
 Ethylolamine  
   See 2-Aminoethanol  
 Ethyl orthopropionate  
   See Triethyl orthopropionate  
 Ethyloxalic acid  
   See Ethyl hydrogen oxalate  
 Ethyl oxide  
   See Ethyl ether  
 Ethyl oxybutyrate  
   See Ethyl  $\alpha$ -hydroxybutyrate  
 Ethyl pentanoate  
   See Ethyl valerate  
 Ethylpentanoic acid  
   See Ethylvaleric acid  
 Ethylphenylacetylene  
   See 1-Phenyl-1-butyne  
 N-Ethylphenylamine  
   See N-Ethylaniline  
 Ethylphenylcarbinol  
   See 1-Phenyl-1-propanol  
 Ethyl phenyl ether  
   See Phenetole  
 Ethyl phenyl ketone  
   See Propiophenone  
 Ethylphenylnitrosoamine  
   See Nitrosoethylaniline  
 Ethyl trans-3-phenylpropenoate  
   See Ethyl trans-cinnamate  
 Ethyl  $\beta$ -phenylpropionate  
   See Ethyl hydrocinnamate  
 Ethyl phosphate  
   See Triethyl phosphate  
 Ethyl phosphite  
   See Triethyl phosphite  
 Ethyl phthalate  
   See Diethyl phthalate  
 Ethyl m-phthalate  
   See Diethyl isophthalate  
 1-Ethyl-1-propanol  
   See sec-m-Amyl alcohol  
 Ethyl propylpropanedioate  
   See Diethyl propylmalonate  
 1-Ethyl-1-propanol  
   See 3-Pentanol  
 Ethylpropionyl  
   See 3-Pentanone  
 Ethylpropylacetic acid  
   See  $\alpha$ -Ethylvaleric acid  
 2-Ethyl-3-propylacrolein  
   See 2-Ethyl-2-hexenal  
 Ethylpropylcarbinol  
   See 3-Hexanol

1-Ethyl-1-propylethylene  
   See 2-Ethyl-1-pentene  
 1-Ethyl-2-propylethylene  
   See 3-Heptene  
 Ethyl n-propyl ketone  
   See 3-Hexanone  
 Ethyl pyromucylacetate  
   See Ethyl  $\alpha$ -furoylacetate  
 Ethyl silicate  
   See Ethyl orthosilicate  
 Ethylsulfinylethane  
   See Ethyl sulfoxide  
 Ethyl sulfuric acid  
   See Ethyl hydrogen sulfate  
 Ethyl tetradecanate  
   See Ethyl myristate  
 Ethyl thioalcohol  
   See Ethanethiol  
 Ethylthioethane  
   See Ethyl sulfide  
 Ethyl thioglycolate  
   See Ethyl mercaptoacetate  
 Ethyl thioglycolic acid  
   See Ethyl mercaptoacetic acid  
 Ethyltoluidine  
   See Diethyltoluidine  
 Ethyltrimethylethylene  
   See 2,3-Dimethyl-2-pentene  
 Ethyltrimethylmethane  
   See 2,2-Dimethylbutane  
 Ethyl urethane  
   See Ethyl ethylcarbamate  
 Ethyl valeriate  
   See Ethyl valerate  
 Ethyl valerianate  
   See Ethyl valerate  
 Ethylvinylcarbinol  
   See 1-Penten-3-ol  
 Ethyl xanthate  
   See Diethyl dithiocarbonate  
 Ethyl xanthogenate  
   See Diethyl dithiocarbonate  
 Eucalyptole  
   See Cineole  
 Eucol  
   See Guaiacol acetate  
 Eugenol  
   See Eugenol  
 Eugenol methyl ether  
   See 4-Allylveratrole  
 Eugenyl methyl ether  
   See 4-Allylveratrole  
 Euresol  
   See Resorcinol acetate  
 Explosive oil  
   See Nitroglycerin

- F-11**  
 See Trichlorofluoromethane  
**d-2-Fenchanone**  
 See d-Fenchone  
**Flexol Plasticizer 4Go**  
 See Polyethylene glycol di-2-ethylhexoate  
**Fluoroethyl alcohol**  
 See Fluoroethanol  
**Fluorovinylbenzene**  
 See Fluorostyrene  
**Formal**  
 See Methylal  
**Formaldehyde diethylacetal**  
 See Diethylformal  
**Formaldehydedimethylacetal**  
 See Methylal  
**Formaldoxime**  
 See Formaldehyde oxime  
**Formalin**  
**Formalith**  
 See Formaldehyde solution  
**Formic aldehyde**  
 See Formaldehyde solution  
**Formol**  
 See Formaldehyde solution  
**Formonitrile**  
 See Hydrocyanic acid  
**Formoxime**  
 See Formaldehyde oxime  
**Formyldiethylamine**  
 See Diethylformamide  
**2-Formylthiophene**  
 See 2-Thiophenecarboxaldehyde  
**Formyl tribromide**  
 See Bromoform  
**Formyl trichloride**  
 See Chloroform  
**Fural**  
 See 2-Furaldehyde  
**2-Furancarbal**  
 See 2-Furaldehyde  
**2-Furancarbinol**  
 See Furfuryl alcohol  
**2-Furancarboxaldehyde**  
 See 2-Furaldehyde  
**2-Furanmethanol**  
 See Furfuryl alcohol  
**2-Furanmethylanine**  
 See Furfurylamine  
**Furfural**  
 See 2-Furaldehyde  
**Furfuralcohol**  
 See Furfuryl alcohol  
**Furfuraldehyde**  
 See 2-Furaldehyde  
**Furfuran**  
 See Furan  
**Furfurancarboxylic aldehyde**  
 See 2-Furaldehyde  
**Furfurole**  
 See 2-Furaldehyde  
**2-Furfuryl chloride**  
 See 2-(Chloromethyl) furan  
**Furfuryl mercaptan**  
 See 2-Furylmethanethiol  
**Furoic acid chloride**  
 See Furoyl chloride  
**Furol**  
 See 2-Furaldehyde  
 **$\beta$ -Furyl bromide**  
 See  $\beta$ -Bromofuran  
 **$\alpha$ -Furylcarbinol**  
 See Furfuryl alcohol  
**Garlic oil**  
 See Allyl sulfide  
**Geosote**  
 See Guaiacol valerate  
**Geranial**  
 See  $\alpha$ -Citral  
**Geranialdehyde**  
 See  $\alpha$ -Citral  
**Geraniol acetate**  
 See Geranyl acetate  
**Geraniol butyrate**  
 See Geranyl butyrate  
**Geraniol tetrahydride**  
 See 2,6-Dimethyl-8-octanol  
**Glaurin**  
 See Diethylene glycol mono-laurate  
**Glonoin oil**  
 See Nitroglycerine  
**Glutaronitrile**  
 See 1,5-Pentanedinitrile  
**Glycerin**  
 See Glycerol  
**Glycerin chlorohydrin**  
 See Chloropropanediol  
**Glycerindichlorohydrin**  
 See 1,3-Dichloro-2-propanol  
**Glycerin monochlorohydrin**  
 See 3-Chloro-1,2-propanediol  
**Glycerol derivatives**  
 See Glyceryl derivatives  
 in Index  
**Glycerolphosphoric acid**  
 See Glycerophosphoric acid  
 **$\alpha$ -Glycerol diiodohydrin**  
 See 1,3-Diiodo-2-propanol  
**Glycerol epichlorohydrin**  
 See Epichlorohydrin  
**Glycerol monobutyrate**  
 See Butyrin  
**Glycerol monopropionin**  
 See Propionin  
**Glyceryl acetate**  
 See Acetin  
**Glyceryl acetin**  
 See Acetin  
**Glyceryl chlorohydrin**  
 See Chloropropanediol  
**Glyceryl dichlorohydrin**  
 See 1,3-Dichloro-2-propanol  
**Glyceryl monoacetate**  
 See Acetin  
**Glyceryl monochlorohydrin**  
 See 3-Chloro-1,2-propanediol  
**Glyceryl triacetate**  
 See Triacetin  
**Glyceryl tribromohydrin**  
 See 1,2,3-Tribromopropane  
**Glyceryl tributyrat**  
 See Tributyrin  
**Glyceryl tricaproate**  
 See Tricaproin  
**Glyceryl tricaprilate**  
 See Tricaprylin  
**Glyceryl trichlorohydrin**  
 See 1,2,3-Trichloropropane  
**Glyceryl triheptylate**  
 See Triheptylin  
**Glyceryl triisovalerate**  
 See Triisovalerin  
**Glyceryl trinitrate**  
 See Nitroglycerin  
**Glyceryl trioleate**  
 See Triolein  
**Glyceryl tripropionate**  
 See Tripropionin  
**Glyceryl trivalerate**  
 See Trivalerin  
**Glycide**  
 See Glycidol  
**Glycol alcohol**  
 See Glycol  
**Glycol alcohol**  
 See Glycol  
**Glycol bis (hydroxyethyl) ether**  
 See Triethylene glycol  
**Glycol bromohydrin**  
 See 2-Bromo-1-ethanol  
**Glycol chlorohydrin**  
 See 2-chloro-1-ethanol  
**Glycol cyanohydrin**  
 See Hydracrylonitrile  
**Glycol diacetate**  
 See 1,2-Ethanediol diacetate

Glycol dibromide  
   See 1,2-Dibromoethane  
 Glycol dibutyrate  
   See 1,2-Ethanediol dibutyrate  
 Glycol dicaprylate  
   See 1,2-Ethanediol dicaprylate  
 Glycol dichloride  
   See 1,2-Dichloroethane  
 Glycol diformate  
   See 1,2-Ethanediol diformate  
 Glycol dipropionate  
   See Ethylene glycol dipropionate  
 Glycol ether  
   See Diethylene glycol  
 Glycol ethylene ether  
   See *p*-Dioxane  
 Glycol ethylidene diacetal  
   See 2-Methyl-1,3-dioxolane  
 Glycol ethylidene ether  
   See 2-Methyl-1,3-dioxolane  
 Glycol formal  
   See 1,3-Dioxolane  
 Glycolic ethyl ether  
   See Ethoxyacetic acid  
 Glycolic methyl ether  
   See Methoxyacetic acid  
 Glycolin  
   See Petrolatum (Liquid)  
 Glycol iodohydrin  
   See 2-Iodo-1-ethanol  
 Glycolmethylene ether  
   See 1,3-Dioxolane  
 Glycol monoacetate  
   See 1,2-Ethanediol monoacetate  
 Glycol monoformate  
   See 1,2-Ethanediol monoformate  
 Glycol monomethyl ether  
   See Methyl "Cellosolve"  
 Glycol monomethyl ether acetate  
   See Methyl "Cellosolve" acetate  
 Glycol nitrate  
   See Ethylene glycol dinitrate  
 Glycol nitrite  
   See Ethylene glycol dinitrite  
 Glycyl alcohol  
   See Glycerol  
 Grain alcohol  
   See Ethyl alcohol

Guaiole  
   See Tiglaldehyde  
 Hemellitene  
   See Hemimellitene  
 Hemiterpene  
   See Isoprene  
 1-Hendecanol  
   See Hendecyl alcohol  
 Heptadecanal  
   See 3,9-Diethyl-6-tridecanal  
 Heptaldehyde  
   See Enanthaldehyde  
 Heptalin acetate  
   See Methylcyclohexyl acetate  
 Heptalin lactate  
   See Methylcyclohexyl lactate  
 Heptamethylene  
   See cycloheptane  
 Heptamethylene glycol  
   See 1,7-Heptanediol  
 Heptanal  
   See Enanthaldehyde  
 Heptanenitrile  
   See Enanthonitrile  
 Heptanoic acid  
   See Enanthic acid  
 Heptanoic aldehyde  
   See Enanthaldehyde  
 Heptanoic anhydride  
   See Enanthic anhydride  
 1-Heptanol  
   See Heptyl alcohol  
*n*-Heptoic acid  
   See Enanthic acid  
 Heptoic aldehyde  
   See Enanthaldehyde  
 Heptylacetylene  
   See 1-Nonyne  
 Heptyl aldehyde  
   See Enanthaldehyde  
 Heptyl bromide  
   See 1-Bromoheptane  
 Heptyl carbinol  
   See Octyl alcohol  
 Heptyl chloride  
   See 1-Chloroheptane  
 Heptyl chloride  
   See 3-Chloro-2,3-dimethylpentane  
 Heptyl cyanide  
   See Caprylonitrile  
 Heptylene  
   See Heptene  
*n*-Heptyl *n*-heptylate  
   See Heptyl enanthate

Heptyl hydride  
   See Heptane  
*n*-Heptylic acid  
   See Enanthic acid  
 Heptylic alcohol  
   See Heptyl alcohol  
 Heptylic anhydride  
   See Enanthic anhydride  
 Heptyl iodide  
   See 1-Iodo-2-methylhexane  
 Heptyl mercaptan  
   See Heptanethiol  
 Heptylmethylcarbinol  
   See 2-Nonanol  
 2-Heptyl-2-methylethanol  
   See 2-Methyl-1-nonanol  
 Heptyl methyl ketone  
   See 2-Nonanone  
 Heptyl oenanthylate  
   See Heptyl enanthate  
 1-Heptyloxyheptane  
   See Heptyl ether  
 Hercolyn  
   See Methyl dihydroabietate  
 Hesperidine  
   See *d*-Limonene  
 Hexadecanoyl chloride  
   See Palmityl chloride  
 $\alpha$ -Hexadecylene  
   See 1-Hexadecene  
 Hexadecyl mercaptan  
   See Hexadecanethiol  
 1,5-Hexadiene  
   See Biallyl  
 1,5-Hexadiene  
   See 1,5-Hexadiyne  
 Hexaethylditin  
   See Triethyltin  
 Hexahydroaniline  
   See Cyclohexylamine  
 Hexahydrobenzene  
   See Cyclohexane  
 1,2,3,4,5,6-Hexahydrophenyl  
   See Phenylcyclohexane  
 Hexahydrocresol  
   See Methylcyclohexanol  
 Hexahydrocresol acetate  
   See Methylcyclohexyl acetate  
 Hexahydrocresol lactate  
   See Methylcyclohexyl lactate  
 Hexahydrocumene  
   See Isopropylcyclohexane  
 Hexahydro-*p*-cymene  
   See *p*-Menthane

- Hexahydrodiethylaniline  
   See *N,N*-Cyclohexylamine  
 Hexahydrodromesitylene  
   See 1,3,5-Trimethyl-cyclohexane  
 Hexahydromethylphenol acetate  
   See Methylcyclohexyl acetate  
 Hexahydromethylphenol lactate  
   See Methylcyclohexyl lactate  
 Hexahydrophenol  
   See Cyclohexanol  
 Hexahydropyridine  
   See Piperidine  
 Hexahydrotoluene  
   See Methylcyclohexane  
 Hexahydroxylene  
   See Dimethylcyclohexane  
 Hexaldehyde  
   See Caproaldehyde  
 Hexalin  
   See Cyclohexanol  
 Hexamethylene  
   See Cyclohexane  
 Hexamethylene dibromide  
   See 1,6-Dibromohexane  
 Hexamethylene diiodide  
   See 1,6-Diiodohexane  
 Hexanal  
   See Caproaldehyde  
 3-Hexanecarboxylic acid  
   See  $\alpha$ -Ethylvaleric acid  
 Hexanedioyl chloride  
   See Adipyl chloride  
 Hexanenitrile  
   See Capronitrile  
 Hexanoic acid  
   See Caproic acid  
 Hexanoic anhydride  
   See Caproic anhydride  
 1-Hexanol  
   See Hexyl alcohol  
 Hexanoyl chloride  
   See Caproyl chloride  
 Hexazane  
   See Piperidine  
 Hexenyl alcohol  
   See 1-Hexen-5-ol  
 Hexoic acid  
   See Caproic acid  
 Hexoic aldehyde  
   See Caproaldehyde  
 Hexolyne  
   See 2-Hexyne
- Hexone  
   See 4-Methyl-2-pentanone  
 Hexyl acetate  
   See Methyl isobutylcarbinol acetate  
 Hexylacetic acid  
   See Caprylic acid  
*n*-Hexylacetylene  
   See 1-Octyne  
 Hexyl aldehyde  
   See Caproaldehyde  
 Hexyl bromide  
   See 1-Bromohexane  
 Hexyl bromide  
   See 5-Bromo-2-methyl-pentane  
 Hexyl chloride  
   See Chlorohexane  
 Hexyl chloride  
   See Chloro-2,3-dimethyl-butane  
*n*-Hexyl cyanide  
   See Enanthonitrile  
 Hexylene  
   See Dimethylbutene  
 Hexylene  
   See Hexene  
 Hexylene  
   See Methylpentene  
 $\alpha$ -Hexylene dibromide  
   See 1,2-Dibromohexane  
 Hexylene glycol  
   See 2-Methyl-2,4-pentanediol  
 1,6-Hexylene iodide  
   See 1,6-Diiodohexane  
 Hexyl hydride  
   See Hexane  
 Hexylic acid  
   See Caproic acid  
*n*-Hexyl iodide  
   See 1-Iodohexane  
 Hexyl mercaptan  
   See Hexanethiol  
 Hexyl methyl ketone  
   See 2-Octanone  
*n*-Hexylphenylcarbinol  
   See 1-Phenyl-1-heptanol  
 Hexyl propyl ketone  
   See 4-Decanone  
 Hexyl *n*-propylmethanol  
   See 4-Decanol  
 High flash naphtha  
   See Naphtha  
 Hydralin  
   See Cyclohexanol  
 Hydrazomethane  
   See sym-Dimethylhydrazine
- Hydrindene  
   See Indane  
 Hydriodic ether  
   See Iodoethane  
 Hydrobromic ether  
   See Bromoethane  
 Hydrochloric ether  
   See Chloroethane  
 Hydrocinnamic aldehyde  
   See Hydrocinnamaldehyde  
 Hydrocinnamic compounds  
   See Hydrocinnamyl compounds  
 Hydrocinnamic nitrile  
   See Hydrocinnamonitrile  
 Hydrocinnamyl alcohol  
   See 3-Phenyl-1-propanol  
 Hydrocyanic ether  
   See Propionitrile  
 Hydrogen cyanide  
   See Hydrocyanic acid  
 Hydrogen methyl sulfate  
   See Methylsulfuric acid  
 Hydroxyacetone  
   See 1-Hydroxy-2-propanone  
*o*-Hydroxybenzaldehyde  
   See Salicylaldehyde  
 3-Hydroxybutanal  
   See Aldol  
 2-Hydroxybutane  
   See *sec*-Butyl alcohol  
 4-Hydroxybutanoic acid  
   See  $\gamma$ -Hydroxybutyric acid  
 4-Hydroxybutanoic acid lactone  
   See Butyrolactone  
 2- or  $\beta$ -Hydroxybutyraldehyde  
   See Aldol  
 $\gamma$ -Hydroxybutyric acid- $\gamma$ -lactone  
   See Butyrolactone  
 $\gamma$ -Hydroxybutyric nitrile  
   See Hydroxybutyronitrile  
*o*-Hydroxychlorobenzene  
   See *o*-Chlorophenol  
 2-Hydroxy-*p*-cymene  
   See Carvacrol  
 Hydroxyethylamine  
   See Aminoethanol  
 $\beta$ -Hydroxyethylaniline  
   See 2-Anilinoethanol  
 Hydroxyethyl ethylenediamine  
   See 2-(2-Aminoethyl-aminoethanol)  
 $\beta$ -Hydroxyethyl formate  
   See 1,2-Ethanediol mono-formate

- Hydroxyethylmercaptan  
   See 2-Mercaptoethanol  
 $\beta$ -Hydroxyethyl phenyl ether  
   See Phenyl "Cellosolve"  
 $\beta$ -Hydroxyethylpiperidine  
   See Piperidineethanol  
 4-Hydroxy-2-keto-4-methyl-pentane  
   See Diacetone alcohol  
 3-Hydroxy-3-methylbutanoic acid  
   See  $\beta$ -Hydroxyisovaleric acid  
 2-Hydroxymethylfuran  
   See Furfuryl alcohol  
 4-Hydroxy-4-methyl-2-pentanone  
   See Diacetone alcohol  
 2-Hydroxy-2-methylpropane-nitrile  
   See  $\alpha$ -Hydroxyisobutyronitrile  
 12-Hydroxy-9-octadecenoic acid  
   See Ricinolic acid  
 2-Hydroxypropanenitrile  
   See Lactonitrile  
 3-Hydroxypropanenitrile  
   See Hydracrylonitrile  
 2-Hydroxypropanoic acid  
   See dl-Lactic acid  
 3-Hydroxypropanoic acid  
   See Hydracrylic acid  
 $\alpha$ -Hydroxypropionic acid  
   See dl-Lactic acid  
 $\beta$ -Hydroxypropionic acid  
   See Hydracrylic acid  
 $\alpha$ -Hydroxytoluene  
   See Benzyl alcohol  
 $m$ -Hydroxytoluene  
   See  $m$ -Cresol  
 2-Hydroxytriethylamine  
   See 2-Diethylaminoethanol  
 $\gamma$ -Hydroxyvaleric lactone  
   See Hydroxy- $\gamma$ -valerolactone  
 Hypnone  
   See Acetophenone  
 Hyponitrous ether  
   See Ethyl nitrite  
 2,2'-Iminodiethanol  
   See Diethanolamine  
 Iminoethyl alcohol  
   See Diethanolamine  
 Iodoacetal  
   See 2,2-Diiodopropane  
 2-Iodo-1,3-dimethylbenzene  
   See Iodo- $m$ -xylene  
 $o$ -Iododiphenyl  
   See  $o$ -Iodobiphenyl  
 Iodoethene  
   See Iodoethylene  
 2-Iodohydrin  
   See 3-Iodo-1-propanol  
 Iodomethyl cyanide  
   See Iodoacetonitrile  
 (Iodomethyl)oxirane  
   See Epiiodohydrin  
 $\alpha$ -Iodonaphthalene  
   See 1-Iodonaphthalene  
 $\gamma$ -Iodopropylene oxide  
   See Epiiodohydrin  
 Iotone  
   See 1,3-Diiodo-2-propanol  
 Isoallylbenzene  
   See Propenylbenzene  
 Isoamoxybenzene  
   See Isoamyl phenyl ether  
 Isoamylacetic acid  
   See Isoenanthic acid  
 Isoamylacetic acid  
   See  $\delta$ -Methylcaproic acid  
 $sec$ -Isoamyl alcohol  
   See 3-Methyl-2-butanol  
 Isoamyl aldehyde  
   See Isovaleraldehyde  
 Isoamyl bromide  
   See 1-Bromo-3-methylbutane  
 Isoamylcarbinol  
   See 4-Methyl-1-pentanol  
 Isoamyl chloride  
   See Chloromethylbutane  
 Isoamyl cyanide  
   See Isocapronitrile  
 $\alpha$ -Isoamylene  
   See 3-Methyl-1-butene  
 $\beta$ -Isoamylene  
   See 2-Methyl-2-butene  
 Isoamylene glycol  
   See Methylbutanediol  
 Isoamyl  $o$ -hydroxybenzoate  
   See Isoamyl salicylate  
 Isoamyl iodide  
   See 1-Iodo-3-methylbutane  
 $\beta$ -Isoamyl-isoamyl alcohol  
   See 3-Isopropyl-5-methyl-1-hexanol  
 Isoamyl isocyanide  
   See Isocaproicisonitrile  
 Isoamyl mercaptan  
   See 3-Methyl-1-butanethiol  
 Isoamylmethylcarbinol  
   See 5-Methyl-2-hexanol  
 Isoamyl methyl ketone  
   See 5-Methyl-2-hexanone  
 $N$ -Isoamylphenylamine  
   See  $N$ -Isoamylaniline  
 Isoamyl phenyl ketone  
   See Isocaprophenone  
 Isoamyl pyromucate  
   See Isoamyl furoate  
 Isobutanol  
   See Isobutyl alcohol  
 Isobutenol  
   See 2-Methyl-2-propen-1-ol  
 Isobutenyl chloride  
   See 3-Chloro-2-methylpropene  
 Isobutoxybenzene  
   See Isobutyl phenyl ether  
 Isobutylacetic acid  
   See Isocaproic acid  
 Isobutylacetonitrile  
   See Isocapronitrile  
 Isobutyl aldehyde  
   See Isobutyraldehyde  
 Isobutyl bromide  
   See 1-Bromo-2-methylpropane  
 Isobutyl carbinol  
   See Isoamyl alcohol  
 Isobutyl chloride  
   See 1-Chloro-2-methylpropane  
 Isobutyl cyanide  
   See Isovaleronitrile  
 Isobutyldimethanol  
   See 2,4-Dimethyl-2-pentanol  
 Isobutyldimethylcarbinol  
   See 2,4-Dimethyl-2-pentanol  
 Isobutyldimethylmethanol  
   See 2,4-Dimethyl-2-pentanol  
 Isobutylene chlorohydrin  
   See Chloromethylpropanol  
 Isobutylene glycol  
   See 2-Methyl-1,2-propanediol  
 Isobutylene oxide  
   See Dimethylethylene oxide  
 Isobutylidene bromide  
   See Dibromomethylpropane  
 Isobutylethylene  
   See 4-Methyl-1-pentene  
 Isobutyl iodide  
   See 1-Iodo-2-methylpropane  
 Isobutylisoamyl  
   See 2,6-Dimethylheptane  
 Isobutyl mercaptan  
   See 2-Methyl-1-propanethiol

- Isobutylmethylecarbinol  
   See 4-Methyl-2-pentanol  
 Isobutyl methyl ketone  
   See 4-Methyl-2-pentanone  
 Isobutyl phenyl ketone  
   See Isovalerophenone  
 Isobutyl propyl ketone  
   See 2-Methyl-4-heptanone  
 Isobutyryl aldehyde  
   See Isobutyraldehyde  
 Isocaproic alcohol  
   See 3-Isopropyl-5-methyl-1-hexanol  
 Isocaproic isonitrile  
   See Isoamyl isocyanide  
 Isocrotyl chloride  
   See Isocrotonyl chloride  
 Isocymene  
   See m-Cymene  
 Isodecane  
   See 2-Methylnonane  
 Isoduridine  
   See 2,3,4,6-Tetramethylaniline  
 Isoestragole  
   See Anethole  
 Isoeugenol methyl ether  
   See 4-Propenylveratrole  
 Isogeraniol  
   See 2,6-Dimethyl-1,3-heptadiene  
 Isoheptane  
   See 2-Methylhexane  
 Isoheptyl alcohol  
   See 5-Methyl-1-hexanol  
 Isoheptylic acid  
   See Isoenanthic acid  
 Isoheptylic acid  
   See  $\delta$ -Methylcaproic acid  
 Isohexane  
   See 2-Methylpentane  
 Isohexyl bromide  
   See 5-Bromo-2-methylpentane  
 Isohexylcarbinol  
   See 5-Methyl-1-hexanol  
*a*-Isonitrobutane  
   See 2-Methyl-1-nitropropane  
 Isononane  
   See 2-Methyloctane  
 Isooctane  
   See 2-Methylheptane  
 Isooctane  
   See 2,2,4-Trimethylpentane  
 Isopentane  
   See 2-Methylbutane  
 Isopropanol  
   See Isopropyl alcohol  
 Isopropanolamine  
   See 1-Amino-2-propanol  
 Isopropenylbenzene  
   See *a*-Methylstyrene  
 Isopropenyl bromide  
   See 2-Bromopropene  
 Isopropenylcarbinol  
   See 2-Methyl-2-propen-1-ol  
 Isopropenyl chloride  
   See 2-Chloropropene  
 Isopropoxybenzene  
   See Isopropyl phenyl ether  
 2-Isopropoxypropane  
   See Isopropyl ether  
 Isopropylacetic acid  
   See Isovaleric acid  
 Isopropylacetylene  
   See 3-Methyl-1-butyne  
*p*-Isopropylaniline  
   See Cumidine  
 Isopropylbenzene  
   See Cumene  
 Isopropyl bromide  
   See 2-Bromopropane  
 Isopropyl carbinol  
   See Isobutyl alcohol  
 Isopropyl chloride  
   See 2-Chloropropane  
 Isopropyl-*o*-cresol  
   See Carvacrol  
 Isopropyl cyanide  
   See Isobutyronitrile  
 Isopropyl cyanohydrin  
   See  $\gamma$ -Hydroxyisobutyronitrile  
 Isopropyldimethylethylene  
   See Dimethylpentene  
 Isopropylethylene  
   See 3-Methyl-1-butene  
 Isopropylethylene glycol  
   See 3-Methyl-1,2-butanediol  
 Isopropyl 2-hydroxypropanoate  
   See Isopropyl lactate  
 Isopropylideneacetone  
   See Mesityl oxide  
 Isopropylidene chloride  
   See 2,2-Dichloropropane  
 Isopropyl iodide  
   See 2-Iodopropane  
 Isopropyl mercaptan  
   See 2-Propanethiol  
 Isopropylmethylacetic acid  
   See *a*, $\beta$ -Dimethylbutyric acid  
 5-Isopropyl-2-methylaniline  
   See Carvacrylamine  
 Isopropylmethylbenzene  
   See Cymene  
 4-Isopropyl-1-methylcyclohexane  
   See *p*-Menthane  
 1-Isopropyl-2-methylethylene  
   See 4-Methyl-2-pentene  
 Isopropyl methyl ketone  
   See 3-Methyl-2-butanone  
 4-Isopropyl-1-methyl-2-nitrobenzene  
   See 2-Nitro-*p*-cymene  
 Isopropylmethylpropylmethane  
   See 2,3-Dimethylhexane  
 Isopropyl phenyl carbinol  
   See *a*-Isopropylbenzyl alcohol  
 Isopropyl phenyl ketone  
   See Isobutyrophenone  
 Isopropyl phenyl methanol  
   See Isopropylbenzyl alcohol  
 Isopropyl phthalate  
   See Diisopropyl phthalate  
 2-(Isopropylthio)propane  
   See Isopropyl sulfide  
 Isopropyltoluene  
   See Cymene  
 Isopropyltrimethylmethane  
   See 2,3,5-Trimethylbutane  
 Isothiocyanill  
   See Allyl isothiocyanate  
 Isovalerial  
   See Isovaleraldehyde  
 Isovaleric acid chloride  
   See Isovaleryl chloride  
 Isovalerone  
   See 2,6-Dimethyl-4-heptanone  
 Isovaleryl diethylamide  
   See N,N-Diethylvaleramide  
 KP-140  
   See Tributyl "Cellosolve" phosphate  
 Kautschin  
   See Dipentene  
 Kapsol  
   See Methyl "Cellosolve" oleate  
 "Kelene"  
   See Chloroethane

- Kelalin  
   See trans-Decalin  
 Ketazine  
   See Acetone azine  
 Ketoheptamethylene  
   See Cycloheptanone  
 Ketohexamethylene  
   See Cyclohexanone  
 Ketopentamethylene  
   See Cyclopentanone  
 Ketopropane  
   See Acetone  
 $\alpha$ -Ketopropionic acid  
   See Pyruvic acid  
 6-Ketosabinane  
   See  $\alpha$ -Thujone  
 $\gamma$ -Ketovaleraldehyde  
   See Levulinaldehyde  
 KP 23  
   See Butyl "Cellosolve"  
   stearate  
 KP-45  
   See Diethylene glycol  
   dipropionate  
 "Kromfax" solvent  
   See 2,2'-Thiodiethanol  
 "Kronisol"  
   See Butyl "Cellosolve"  
   phthalate  
 Kronitex AA  
   See Tolyphosphate  
 Lachrymite  
   See Thiophosgene  
 Lactic acid nitrile  
   See Lactonitrile  
 Lauric acid chloride  
   See Lauroyl chloride  
 Lauric acid nitrile  
   See Lauronitrile  
 Lauryl acetate  
   See Dodecyl acetate  
 Lauryl bromide  
   See 1-Bromododecane  
 Lauryl chloride  
   See 1-Chlorododecane  
 Lauryl mercaptan  
   See 1-Dodecanethiol  
 Lead tetraethide  
   See Tetraethyllead  
 Lead Tetraethyl  
   See Tetraethyllead  
 Lead tetramethyl  
   See Tetramethyllead  
 Leucoline  
   See Isoquinoline  
 Leucoline  
   See Quinoline  
 Leukol  
   See Quinoline  
 Levulinic acid aldehyde  
   See Levulinaldehyde  
 Licareol acetate  
   See 1-Linalool acetate  
 Lignoïn light  
   See Petroleum ether  
 Lima oil  
   See Petroleum  
 Limonene (dl)  
   See Dipentene  
 Linaloolene  
   See 3,7-Dimethyl-1,6-  
   octadiene  
 Linalool tetrahydride  
   See 2,6-Dimethyl-6-  
   octanol  
 Linalyl acetate  
   See 1-Linalool acetate  
 Linolic acid  
   See Linoleic acid  
 Liquid paraffin  
   See Petrolatum (Liquid)  
 Lupinidine  
   See Sparteine  
 $\alpha$ -Lutidine  
   See 2-Ethylpyridine  
 Malonic ester  
   See Ethyl malonate  
 Mandelic acid nitrile  
   See dl-Mandelonitrile  
 Manhattan spirits  
   See Methanol  
 Menthadiene  
   See Phellandrene  
 1,3-p-Menthadiene  
   See  $\alpha$ -Terpinene  
 1,4(8)-p-Menthadiene  
   See Terpinolene  
d-1,8(9)-m-Menthadiene  
   See d-Sylvestrene  
d-1,8(9)-p-Menthadiene  
   See d-Limonene  
dl-1,8(9)-p-Menthadiene  
   See dl-Limonene  
 3,1,7-p-Menthadiene  
   See  $\beta$ -Terpinene  
d-6,8(9)-p-Menthadien-2-one  
   See d-Carvone  
p-Menth-8(9)-en-2-one  
   See 1-Dihydrocarvone  
 1-3-p-Menthane  
   See 1-Menthone  
d-3-p-Menthene  
   See d-Menthene  
dl-1-p-Menthen-8-ol  
   See dl- $\alpha$ -Terpineol  
 4(8)-p-Menthen-3-one  
   See Pulegone  
 Menthonaphthene  
   See p-Menthane  
 2-Mercaptoethanoic acid  
   See Mercaptoacetic acid  
 Mercury dibutyl  
   See Dibutylmercury  
 Mercury diethyl  
   See Diethylmercury  
 Mercury dimethyl  
   See Dimethylmercury  
 Mercury di-n-propyl  
   See Dipropylmercury  
 Mesotan  
   See Methoxyethyl methyl  
   Salicylate  
 Metacetone  
   See 3-Pentanone  
 Metactonic acid  
   See Propionic acid  
 Metadiazine  
   See Pyrimidine  
 Metathiazole  
   See Thiazole  
 Methacrolein  
   See Methacrylaldehyde  
 Methallyl alcohol  
   See 2-Methyl-2-propen-1-  
   ol  
 $\beta$ -Methallyl chloride  
   See 3-Chloro-2-methyl-  
   propene  
 Methanamide  
   See Formamide  
 Methanecarbolthiolic acid  
   See Thiolacetic acid  
 Methanecarboxylic acid  
   See Acetic acid (glacial)  
 Methanediol diacetate  
   See Methylene acetate  
 Methanethiomethane  
   See Methyl sulfide  
 Methanoic acid  
   See Formic acid  
 Methenyl  
   See Ethyl formate  
 Methenyl tribromide  
   See Bromoform  
 Methenyl trichloride  
   See Chloroform  
 Methox  
   See Dimethyl "Cellosolve"  
   phthalate  
p-Methoxyallyl phenol  
   See Estragole

- Methoxyaniline  
   See Anisidine  
 p-Methoxybenzaldehyde  
   See Anisaldehyde  
 Methoxybenzene  
   See Anisole  
 p-Methoxybenzoyl chloride  
   See Anisoyl chloride  
 o-Methoxybenzyl alcohol  
   See 2-Methyl saligenin ether  
 Methoxybutane  
   See Butyl methyl ether  
 Methoxyethane  
   See Ethyl methyl ether  
 Methoxyethanoic acid  
   See Methoxyacetic acid  
 2-Methoxyethanol  
   See Methyl "Cellosolve"  
 2-Methoxyethanol acetate  
   See Methyl "Cellosolve" acetate  
 2-( $\beta$ -Methoxyethoxy) ethanol  
   See Methyl "Carbitol"  
 Methoxyethyl acetyl ricinoleate  
   See Methyl "Cellosolve" acetylricinoleate  
 Methoxyethyl oleate  
   See Methyl "Cellosolve" oleate  
 1-Methoxyheptane  
   See Heptyl methyl ether  
 2-Methoxy-4-methylphenol  
   See Cresol  
 1-Methoxy-2-methylpropane  
   See Isobutyl methyl ether  
 1-Methoxynaphthalene  
   See Methyl-1-naphthyl ether  
 1-Methoxy-2-nitrobenzene  
   See o-Nitroanisole  
 1-Methoxypentane  
   See Amyl methyl ether  
 1-Methoxypropane  
   See Methyl propyl ether  
 2-Methoxypropane  
   See Isopropyl methyl ether  
 Methoxypropenyl benzene  
   See Anethole  
 Methoxytoluene  
   See Methyl tolyl ether  
 Methylacetaldehyde  
   See Propionaldehyde  
 Methylacetic acid  
   See Propionic acid  
 Methylacetyl  
   See Acetone  
 $\alpha$ -Methylacrolein  
   See Methacrylaldehyde  
 $\beta$ -Methylacrolein  
   See Crotonaldehyde  
 $\alpha$ -Methylacrylic acid  
   See Methacrylic acid  
 Methyl alcohol  
   See Methanol  
 Methylallene  
   See 1,2-Butadiene  
 $\gamma$ -Methylallyl alcohol  
   See 2-Buten-1-ol  
 Methyl o-aminobenzoate  
   See Methyl anthranilate  
 Methyl aminoethanoate  
   See Methyl glycinate  
 Methylamino methylbenzoate  
   See Methyl N-methylantranilate  
 Methylamino-2-methylheptene  
   See N,1,5-Trimethyl-4-hexenylamine  
 Methylamyl acetate  
   See 1,3-Dimethylbutyl acetate  
 m-Methylamylbenzene  
   See Amyltoluene  
 Methyl amyl ketone  
   See 2-Heptanone  
 Methylaniline  
   See Toluidine  
 Methyl anisate  
   See Methyl o-methoxybenzoate  
 Methyl Anon  
   See Methylcyclohexanone  
 Methylbenzaldehyde  
   See Tolualdehyde  
 Methylbenzene  
   See Toluene  
 Methylbenzenecarbonal  
   See Tolualdehyde  
 Methylbenzenecarbonitrile  
   See Tolunitrile  
 Methylbenzol  
   See Toluene  
 Methylbenzonitrile  
   See Tolunitrile  
 2-Methyl benzothiazole  
   See Ethenylaminothiophenol  
 2-Methyl benzoxazole  
   See Ethenylaminophenol  
 $\alpha$ -Methylbivinyll  
   See Piperylene  
 $\beta$ -Methylbivinyll  
   See Isoprene  
 Methyl borate  
   See Trimethyl borate  
 Methyl bromide  
   See Bromomethane  
 Methyl-4-bromohydrindene  
   See 4-Bromo-7-methylindene  
 Methylbutadiene  
   See Isoprene  
 2-Methyl-1-butanal  
   See  $\alpha$ -Methylbutyraldehyde  
 Methylbutanal  
   See Isovaleraldehyde  
 3-Methylbutanenitrile  
   See Isovaleronitrile  
 2-Methylbutanoic acid  
   See  $\alpha$ -Methylbutyric acid  
 3-Methylbutanoic acid  
   See Isovaleric acid  
 1-Methyl-1-butanol  
   See sec-Amyl alcohol  
 1-Methyl-1-butanol  
   See 2-Pentanol  
 2-Methyl-1-butanol  
   See tert-Amyl alcohol  
 3-Methyl-1-butanol acetate  
   See Isoamyl acetate  
 4-Methyl-2-butanol  
   See Isoamyl alcohol  
 3-Methyl-1-butanol benzoate  
   See Isoamyl benzoate  
 3-Methylbutanoyl chloride  
   See Isovaleryl chloride  
 2-Methyl-2-butenal  
   See Tiglaldehyde  
 2-( $\gamma$ -Methylbutoxyl) naphthalene  
   See Isoamyl 2-naphthyl ether  
 $\alpha$ -Methylbutyl acetate  
   See sec-Amyl acetate  
 $\alpha$ -Methylbutylamine  
   See sec-Amylamine  
 $\alpha$ -Methylbutylbenzene  
   See sec-Amylbenzene  
 Methylbutylbenzene  
   See m-Butyltoluene  
 $\gamma$ -Methylbutyl butanoate  
   See Isoamyl butyrate  
 Methyl tert-butylcarbinol  
   See Pinacolyl alcohol  
 $\gamma$ -Methylbutyl compounds  
   See Isoamyl compounds  
 Methyl n-butyl methane  
   See Hexane  
 $\gamma$ -Methylbutyl-3-methylbutanoate  
   See Isoamyl isovalerate

$\gamma$ -Methylbutyl 2-methylpropanoate  
 See Isoamyl isobutyrate  
 $\gamma$ -Methylbutyl octadecanoate  
 See Isoamyl stearate  
 $\gamma$ -Methylbutyl octanoate  
 See Isoamyl caprylate  
 2-Methyl-4-tert-butyl phenol  
 See p-tert-Butyl-o-cresol  
 $\beta$ -Methylbutyric acid  
 See Isovaleric acid  
 $\delta$ -Methylcaproic acid  
 See Isoenanthic acid  
 Methyl carbinol  
 See Ethyl alcohol  
 Methyl carbonimide  
 See Methyl isocyanate  
 Methyl chloroethanoate  
 See Methyl chloroacetate  
 Methylchloroform  
 See 1,1,1-Trichloroethane  
 Methyl-4-chlorohydrindene  
 See 4-Chloro-7-methylindan  
 Methyl citraconate  
 See Dimethyl citraconate  
 Methyl cyanide  
 See Acetonitrile  
 Methylcyanoacetic acid  
 See Cyanopropionic acid  
 Methylcyclohexadiene  
 See Dihydrotoluene  
 Methyl cyclohexadiene  
 See Dihydrotoluene  
 3-Methylcyclopentadecanone  
 See 1-Muscone  
 Methyl decanoate  
 See Methyl caprate  
 Methyl diethanolamine  
 See 2,2'-Methylimino-diethanol  
 Methyl diethylaminobenzene  
 See N,N-Diethyltoluidine  
 Methyl dipropylcarbinol  
 See 4-Methyl-4-heptanol  
 Methyl dipropylmethane  
 See 4-Methylheptane  
 Methyl dithiomethane  
 See Methyl disulfide  
 $\beta$ -Methyldivinyl  
 See Isoprene  
 Methylene bichloride  
 See Dichloromethane  
 Methylene bromide  
 See Dibromomethane  
 Methylene bromochloride  
 See Bromochloromethane  
 Methylene chloride  
 See Dichloromethane

Methylenechlorobromide  
 See Bromochloromethane  
 Methylene chloriodide  
 See Chloriodomethane  
 Methylene diacetate  
 See Methylene acetate  
 Methylene diethyl ether  
 See Diethylformal  
 Methylene dimethylate  
 See Methylal  
 Methylene dimethyl ether  
 See Methylal  
 3,4-Methylenedioxyallylbenzene  
 See Safrole  
 Methylene dipropylene ether  
 See Propylal  
 3-Methylenehexane  
 See 2-Ethyl-1-pentene  
 Methylene iodide  
 See Diiodomethane  
 Methyl ethyl acetaldehyde  
 See  $\alpha$ -Methylbutyraldehyde  
 Methyleneethylacetic acid  
 See  $\alpha$ -Methylbutyric acid  
 Methyleneethylacetone  
 See  $\alpha$ -Methylbutyronitrile  
 Methyleneethylene glycol  
 See 1,2-Propanediol  
 sym-Methyleneethylene  
 See 2-Pentene  
 Methyleneethylene glycol  
 See 2,3-Pentanediol  
 Methyl ethyl ketone  
 See 2-Butanone  
 Methyl ethyl ketoxime  
 See 2-Butanone oxime  
 Methyleneethylpyridine  
 See Collidine  
 Methyleneugenol  
 See 4-Allylveratrole  
 Methylfurfural  
 See 5-Methyl-2-furaldehyde  
 Methylfurfurane  
 See 2-Methylfuran  
 5-Methylfurfurole  
 See 5-Methyl-2-furaldehyde  
 Methyl glycerinate  
 See Methyl glycerate  
 Methyl glycerine chlorohydrin ( $\beta'$ , mono)  
 See 3-Chloro-2-methyl-1,2-propanediol  
 Methyl glycol  
 See 1,2-Propanediol  
 Methylglycolic acid  
 See Methoxyacetic acid

Methyl glycol phthalate  
 See Dimethyl "Cellosolve" phthalate  
 Methylglyoxaline  
 See 1-Methylimidazole  
 4-Methylguaiaicol  
 See Cresol  
 Methyl heptanoate  
 See Methyl enanthate  
 Methyl n-heptylate  
 See Methyl enanthate  
 Methylhexalin acetate  
 See Methylcyclohexyl acetate  
 Methylhexalin lactate  
 See Methylcyclohexyl lactate  
 Methylhexalin "Sextate"  
 See Methylcyclohexyl acetate  
 5-Methylhexanoic acid  
 See Isoenanthic acid  
 Methylhexanoic acid  
 See Methylcaproic acid  
 Methylhexylcarbinol  
 See 2-Octanol  
 Methyl hydrate  
 See Methanol  
 Methyl hydrogen adipate  
 See Methyl mono adipate  
 Methyl hydrogen sulfate  
 See Methylsulfuric acid  
 Methyl hydroxide  
 See Methanol  
 Methyl 3-hydroxybutanoate  
 See Methyl-3-hydroxybutyrate  
 Methyl hydroxyethanoate  
 See Methyl glycolate  
 Methyl 2-hydroxypropanoate  
 See Methyl lactate  
 Methyl hydroxysuccinate  
 See Methyl malate  
 Methyl alcohol  
 See Methanol  
 Methyl iodide  
 See Iodomethane  
 1-Methylisoamyl acetate  
 See 1,3-Dimethylbutyl acetate  
 Methyl isoamyl ketone  
 See 5-Methyl-2-hexanone  
 Methyl isobutenyl ketone  
 See Mesityl oxide  
 $\alpha$ -Methylisoamyl butyrate  
 See 4-Methyl-2-pentanol butyrate

Methylisobutylcarbinol  
   See 4-Methyl-2-pentanol  
 Methylisoeugenol  
   See 4-Propenylveratrole  
 Methylisopropyl carbinol  
   See 3-Methyl-2-butanol  
 Methylisopropylcarbinyllamine  
   See Dimethylpropylamine  
 Methyl isopropyl ketone  
   See 3-Methyl-2-butanone  
 2-Methyl-5-isopropyl phenol  
   See Carvacrol  
 Methylmaleic anhydride  
   See Citraconic anhydride  
 Methylmalonic mononitrile  
   See Cyanopropionic acid  
 Methyl mercaptan  
   See Methanethiol  
 Methyl mesaconate  
   See Dimethyl mesaconate  
 Methyl methylaminobenzoate  
   See Methyl *N*-methylantranilate  
 Methyl 3-Methylbutanoate  
   See Methyl isovalerate  
 3-Methyl-1-( $\gamma$ -methylbutoxy)butane  
   See Isoamyl ether  
 3-Methyl-1-( $\gamma$ -methylbutylthio)butane  
   See Isoamyl sulfide  
 Methyl 2-methylpropanoate  
   See Methyl isobutyrate  
 (2-Methyl-1- $\beta$ -methylpropoxy)propane  
   See Isobutyl ether  
 1-Methyl-1-( $\alpha$ -methylpropylthio)propane  
   See *sec*-Butyl sulfide  
 Methylnitrobenzene  
   See Nitrotoluene  
 Methyl nonanoate  
   See Methyl pelargonate  
 Methylnonylcarbinol  
   See 2-Hendecanol  
 Methyl nonyl ketone  
   See 2-Hendecanone  
 Methyl octanoate  
   See Methyl caprylate  
 Methyl octyl ketone  
   See 2-Decanone  
 Methyl oenanthylate  
   See Methyl enanthate  
 3-Methylolpentane  
   See 2-Ethyl-1-butanol  
 Methyl *p*-oxybenzaldehyde  
   See Anisaldehyde

Methyloxirane  
   See Propylene oxide  
 Methyloxirene  
   See 1,2-Epoxypropene  
 Methyl 2-oxopropanoate  
   See Methyl pyruvate  
 4-Methylpentanenitrile  
   See Isocapronitrile  
 Methyl pentanoate  
   See Methyl valerate  
 4-Methylpentanoic acid  
   See Isocaproic acid  
 2-Methyl-pentene-2-al-1  
   See Methyl  $\beta$ -ethylacrolein (*d*)  
 4-Methyl-3-penten-2-one  
   See Mesityl oxide  
 4-Methylpentyl acetate-2  
   See 4-Methyl-2-pentanol acetate  
*dl*- $\alpha$ -Methylphenethylamine  
   See Benzedrine  
*m*-Methylphenol  
   See *m*-Cresol  
 3-Methyl-1-phenoxybutane  
   See Isoamyl phenyl ether  
 2-Methyl-1-phenoxypropane  
   See Isobutyl phenyl ether  
 Methylphenylamine  
   See *N*-Methylaniline  
 Methylphenylbromomethane  
   See  $\alpha$ -Bromoethylbenzene  
 3-Methyl-1-phenylbutane  
   See Isoamylbenzene  
 3-Methyl-2-phenylbutane  
   See *tert*-Amylbenzene  
 3-Methyl-1-phenyl-1-butanone  
   See Isovalerophenone  
 Methylphenylcarbinol  
   See  $\alpha$ -Methylbenzyl alcohol  
 Methyl phenyl diketone  
   See Acetylbenzoyl  
 Methyl phenyl ether  
   See Anisole  
*dl*- $\alpha$ -Methylphenylethylamine  
   See Benzedrine  
*unsym*-Methylphenylethylene  
   See  $\alpha$ -Methylstyrene  
 Methyl phenyl ketone  
   See Acetophenone  
 4-Methyl-1-phenylpentane  
   See Isohexylbenzene  
 2-Methyl-1-phenylpropane  
   See Isobutylbenzene  
 2-Methyl-2-phenylpropane  
   See *tert*-Butylbenzene  
 Methyl phosphate  
   See Trimethyl phosphate

Methyl phthalate  
   See Dimethyl phthalate  
 Methylpiperidine  
   See Pipecoline  
 2-Methylpropanal  
   See Isobutyraldehyde  
 2-Methylpropanenitrile  
   See Isobutyronitrile  
 Methyl propanoate  
   See Methyl propionate  
 2-Methylpropanoic acid  
   See Isobutyric acid  
 2-Methyl-1-propanol  
   See Isobutyl alcohol  
 2-Methyl-2-propanol  
   See *tert*-Butyl alcohol  
 2-Methylpropanoyl bromide  
   See Isobutyryl bromide  
 2-Methylpropanoyl chloride  
   See Isobutyryl chloride  
 Methyl propargyl ether  
   See Methyl 2-propynyl ether  
 2-Methylpropenal  
   See Methacrylaldehyde  
 2-Methylpropenoic acid  
   See Methacrylic acid  
 Methyl propenyl ketone  
   See 3-Penten-2-one  
 3-Methyl-1-propoxybutane  
   See Isoamyl propyl ether  
 2-( $\alpha$ -Methylpropoxy)butane  
   See *sec*-Butyl ether  
 2-Methyl-1-propoxypropane  
   See Isobutyl propyl ether  
 $\alpha$ -Methylpropyl acetate  
   See *sec*-Butyl acetate  
 Methylpropylacetylene  
   See 2-Hexyne  
 ( $\alpha$ -Methylpropyl)amine  
   See *sec*-Butylamine  
 Methylpropylbenzene  
   See Propyltoluene  
 $\beta$ -Methylpropyl benzene-carboxylate  
   See Isobutyl benzoate  
 $\beta$ -Methylpropyl compounds  
   See Isobutyl compounds  
 Methylpropylcarbinol  
   See 2-Pentanol  
 Methylpropylcarbinol  
   See *sec*-act-Amyl alcohol  
 Methylpropylcarbinyllamine  
   See *sec*-Amylamine  
 2-Methylpropyl ethanoate  
   See *sec*-Butylacetate  
 2-Methyl-2-propylethanol  
   See 2-Methyl-1-pentanol

1-Methyl-1-propylethylene  
See 2-Methyl-1-pentene  
1-Methyl-2-propylethylene  
See 2-Hexene  
 $\beta$ -Methylpropyl-12-hydroxy-9-octadecenoate  
See Isobutyl ricinoleate  
 $\alpha$ -Methylpropyl isothiocyanate  
See *sec*-Butyl isothiocyanate  
Methyl propyl ketone  
See 2-Pentanone  
 $\beta$ -Methylpropyl 3-methylbutanoate  
See Isobutyl isovalerate  
 $\beta$ -Methylpropyl -2-methylpropanoate  
See Isobutyl isobutyrate  
 $\alpha$ -Methylpropyl nitrate  
See *sec*-Butyl nitrate  
 $\alpha$ -Methylpropyl nitrite  
See *sec*-Butyl nitrite  
 $\beta$ -Methylpropyl pentanoate  
See Isobutyl valerate  
Methylpyridine  
See Picoline  
N-Methylpyrrolidine  
See 1-Methylpyrrolidine  
Methyl pyruvate  
See Methyl pyruvate  
4-Methylquinaldine  
See 2,4-Dimethylquinoline  
 $\alpha$ - or 2-Methylquinoline  
See Quinaldine  
 $\beta$ -Methylquinoline  
See 3-Methylquinoline  
 $\gamma$ - or 4-Methylquinoline  
See Lepidine  
Methylsulfinylmethane  
See Methyl sulfoxide  
Methylsulfone chloride  
See Methanesulfonyl chloride  
Methylsulfonic acid  
See Methanesulfonic acid  
Methyl Sulfonic chloride  
See Methanesulfonyl chloride  
Methyltetrahydroquinoline  
See Kairolin  
Methyl tetramethylene  
See Methylcyclobutane  
Methylthiomethane  
See Methyl sulfide  
 $\beta$ -Methylthiotoluene  
See 3-Methylthiophene

$\alpha$ -Methyl- $\alpha$ -toluic acid  
See Hydratropic acid  
Methyl p-tolyl ketone  
See p-Methylacetophenone  
Methyl trichloride  
See Chloroform  
Methyl trimethylacetate  
See Methyl pivalate  
 $\alpha$ -Methyltrimethylene glycol  
See 1,3-Butanediol  
Methyl undecylenate  
See Methyl 10-hendecenoate  
Methylpyridine  
See Picoline  
Methylvinylcarbinol  
See 3-Buten-2-ol  
Methyl vinyl ketone  
See 3-Buten-2-one  
Methylvinylmethanol  
See 3-Buten-2-ol  
Mezcaline  
See Mescaline  
Miazine  
See Pyrimidine  
Monacetin  
See Acetin  
Monochloroacetone  
See 1-Chloro-2-propanone  
 $\alpha$ -Monochlorohydrin  
See 3-Chloro-1,2-propanediol  
 $\beta$ -Monochlorohydrin  
See 2-Chloro-1,3-propanediol  
Monoethanolamine  
See 2-Aminoethanol  
Mono- $\alpha$ -glycerolamine  
See 1-Amino-2,3-propanediol  
Monothioglycol  
See 2-Mercaptoethanol  
Moogrol  
See Ethyl chaulmoograte  
2-(4-Morpholinyl)ethanol  
See 4-Morpholineethanol  
Muriatic ether  
See Chloroethane  
Mustard gas  
See Bis (2-chloroethyl) sulfide  
Mustard oil  
See Allyl isothiocyanate  
Muthmann's liquid  
See 1,1,2,2-Tetrabromoethane  
Myristic acid chloride  
See Myristoyl chloride

Myristyl bromide  
See 1-Bromotetradecane  
Myristyl chloride  
See Myristoyl chloride  
Myristyl mercaptan  
See 1-Tetradecanethiol  
Naphtha  
See Mineral spirits  
Naphthaline  
See *trans*-Decalin  
1-Naphthalenecarbonal  
See 1-Naphthaldehyde  
Naphthalene 1,2,3,4-tetrahydride  
See Tetralin  
Naphthane  
See *trans*-Decalin  
 $\alpha$ -Naphthoic aldehyde  
See 1-Naphthaldehyde  
 $\alpha$ -Naphthyl bromide  
See 1-Bromonaphthalene  
 $\alpha$ -Naphthyl chloride  
See 1-Chloronaphthalene  
 $\alpha$ -Naphthylethane  
See 1-Ethyl-naphthalene  
 $\beta$ -Naphthylethane  
See 2-Ethyl-naphthalene  
Naphthyl fluoride  
See 1-Fluoronaphthalene  
 $\alpha$ -Naphthyl iodide  
See 1-Iodonaphthalene  
 $\alpha$ -Naphthyl mercaptan  
See 1-Naphthalenethiol  
Naphthylmethylamine  
See N-Methylnaphthylamine  
Neohexane  
See 2,2-Dimethylbutane  
Nitric ether  
See Ethyl nitrate  
Nitroallyl  
See 3-Nitro-1-propene  
Nitrobenzide  
See Nitrobenzene  
Nitrobromoforn  
See Bromopicrin  
*tert*-Nitrobutane  
See 2-Methyl-2-nitropropane  
 $\beta$ -Nitrobutyl alcohol  
See 2-Nitro-1-butanol  
Nitrochloroform  
See Chloropicrin  
Nitrochloromethane  
See Chloropicrin  
1-Nitrodecane  
See 2,7-Dimethyl-1-nitro-octane

**2-Nitrodecane**

See 2,7-Dimethyl-2-nitro-octane

**Nitrodiphenyl ether**

See Nitrophenyl phenyl ether

**Nitroethyl alcohol**

See 2-Nitroethanol

**Nitroheptane**

See Dimethylnitropentane

**Nitroheptane**

See 3-Ethyl-3-nitropentane

**Nitrohexane**

See 2-Methyl-2-nitropentane

(*α*-Nitroisopropyl) benzene

See *α*-Nitrocumene

**Nitrononane**

See 2,6-Dimethyl-2-nitro-heptane

**Nitrooctane**

See 2,5-Dimethyl-1-nitro-hexane

**Nitropentane**

See 2-Methyl-2-nitrobutane

**Nitropentane**

See 2-Methyl-4-nitrobutane

*o*-Nitrophenyl methyl ether

See *o*-Nitroanisole

*p*-Nitro-2-phenylpropane

See *α*-Nitrocumene

*N*-Nitroso-*N*-ethyl carbamate

See Nitroso *N*-ethyl

urethane

Nitrotrichloromethane

See Chloropicrin

**Nitrous diethylamide**

See *N,N*-Diethylnitrosamine

**Nitrous dimethylamide**

See *N*-Nitrosodimethylamine

**Nitrous dipropylamide**

See *N*-Nitrosodipropylamine

**Nitrous ether**

See Ethyl nitrite

*p*-Nitro-2-vinylbenzene

See *o*-Nitrostyrene

*m*-Nitro-3-vinylbenzene

See *m*-Nitrostyrene

**Nonanal**

See Pelargonaldehyde

**Nonanoic acid**

See Pelargonic acid

**-Nonanol**

See Nonyl alcohol

**Nonanoyl chloride**

See Pelargonyl chloride

**Nonoic acid**

See Pelargonic acid

**Nonyl bromide (2)**

See 2-Bromononane

**Nonyl chloride (2)**

See 2-Chlorononane

***n*-Nonyl cyanide**

See Caprinitrile

**Nonylene**

See Nonene

**Nonyl hydride**

See Nonane

***n*-Nonylic acid**

See Pelargonic acid

***n*-Nonyl iodide**

See 1-Iodononane

**Nonylmethanol**

See 1-Decanol

**Normenthane**

See Isopropylcyclohexane

**Octadecatrienoic acid**

See Linolenic acid

**9-Octadecenoic acid**

See Oleic acid

***cis*-9-Octadecen-1-ol**

See Oleyl alcohol

***cis*-Octadecenyl alcohol**

See Oleyl alcohol

***α*-Octadecylene**

See 1-Octadecene

**Octadiene-*x,x***

See Conylene

**Octahydropyrrocoline**

See Piperolidine

**Octamethylene**

See Cyclooctane

**Octanal**

See Caprylaldehyde

**Octandial**

See Suberaldehyde

**Octanenitrile**

See Caprylonitrile

**Octanoic acid**

See Caprylic acid

**Octanoic anhydride**

See Caprylic anhydride

**1-Octanol**

See Octyl alcohol

**Octanol**

See 2-Ethyl-1-hexanol

**Octanoyl chloride**

See Caprylyl chloride

**Octic acid**

See Caprylic acid

**Octin**

See *N*,1,5-Trimethyl-4-hexenylamine

**Octinum**

See *N*,1,5-Trimethyl-4-hexenylamine

**Octoic acid**

See Caprylic acid

**Octoic alcohol**

See Octyl alcohol

**Octoic anhydride**

See Caprylic anhydride

**Octoic bromide**

See 1-Bromooctane

**Octyl acetate**

See 2-Ethylhexyl acetate

***n*-Octylacetylene**

See 1-Decyne

**Octylaldehyde**

See Caprylaldehyde

**Octyl bromide**

See Bromooctane

**Octyl chloride**

See Chlorooctane

**Octyl cyanide**

See Nonanenitrile

**Octyl fluoride**

See 1-Fluorooctane

**Octyl hydride**

See Octane

**Octylic acid**

See Caprylic acid

**Octylic alcohol**

See Octyl alcohol

**Octylic bromide**

See 1-Bromooctane

**Octyl iodide**

See Iodooctane

**Octyl mercaptan**

See Octanethiol

**Octyloxyoctane**

See Octyl ether

**Octyl phthalate**

See Dioctyl phthalate

**Oenanthic**

See Enanthic

**Oenanthyldiene**

See 1-Heptyne

**Oenanthylic nitrile**

See Enanthonitrile

**Oil of bitter almonds**

See Benzaldehyde

**Oil of Mirbane**

See Nitrobenzene

**Oil of Myrbane**

See Nitrobenzene

**Oil of Niobe**

See Methyl benzoate

**Oleinic acid**

See Oleic acid

**Orthene**

See 1,2-Dichlorobenzene

**Orthophen 85**

See Amylphenol

- Orthodiazine  
   See Pyridazine  
 Oxalaldehyde  
   See Glyoxal  
 Oxalic acid chloride  
   See Oxalyl chloride  
 Oxirane  
   See Ethylene oxide  
 4-Oxopentanal  
   See Levulinaldehyde  
 2-Oxopropanenitrile  
   See Pyruvonnitrile  
 2-Oxopropanoic acid  
   See Pyruvic acid  
 2-Oxopyrrolidine  
   See 2-Pyrrolidone  
 o-Oxybenzaldehyde  
   See Salicylaldehyde  
 Oxybutyric aldehyde  
   See Aldol  
 Oxycymol  
   See Carvacrol  
 2,2'-Oxydiethanol  
   See Diethylene glycol  
 1,1'-Oxydi-2-propanol  
   See Dipropylene glycol  
 Oxyisobutyric nitrile  
   See  $\alpha$ -Hydroxyisobutyronitrile  
 p-Oxy-m-methoxyallylbenzene  
   See Eugenol  
 m-Oxytoluene  
   See m-Cresol  
 Palmitic acid chloride  
   See Palmityl chloride  
 Palmitoyl chloride  
   See Palmityl chloride  
 Paracetaldehyde  
   See Paraldehyde  
 Paraffin oil  
   See Petrolatum (Liquid)  
 Parvuline  
   See  $\beta$ -Parvoline  
 Pear oil  
   See Isoamyl acetate  
 Pelargonic acid aldehyde  
   See Pelargonaldehyde  
 Pelargonic acid chloride  
   See Pelargonyl chloride  
 Pelargonic acid nitrile  
   See Nonanenitrile  
 Pelargonitrile  
   See Nonanenitrile  
 Pentacetate  
   See Amyl acetate  
 Pentadecyl bromide  
   See Bromopentadecane  
 1,3-Pentadiene  
   See Piperylene  
 Pentalene 92  
   See Amylnaphthalene  
 Pentalene 90  
   See Diamylnaphthalene  
 Pentalin  
   See Pentachloroethane  
 Pentamethylene  
   See Cyclopentane  
 Pentamethylene diamine  
   See Cadaverine  
 Pentamethylene dibromide  
   See 1,5-Dibromopentane  
 Pentamethylene dichloride  
   See 1,5-Dichloropentane  
 Pentamethylene diiodide  
   See 1,5-Diiodopentane  
 Pentamethylene glycol  
   See 1,5-Pentanediol  
 Pentamethyleneimine  
   See Piperidine  
 Pentamethylene oxide  
   See Tetrahydropyran  
 Pentamethylethyl alcohol  
   See 2,2,3-Trimethyl-2-butanol  
 Pentanal  
   See Valeraldehyde  
 3-Pentanecarboxylic acid  
   See 2-Ethylbutyric acid  
 1,5-Pentanediamine  
   See Cadaverine  
 Pentanenitrile  
   See Valeronitrile  
 Pentanoic acid  
   See Valeric acid  
 Pentanoic anhydride  
   See Valeric anhydride  
 Pentanol  
   See Amyl alcohol  
 1-Pentanol acetate  
   See Amyl acetate  
 Pentanoyl chloride  
   See Valeryl chloride  
 Pentanpentol  
   See Xylitol  
 Pentapropionyl glycoside  
   See Glucosepenta-propionate  
 Pentaryl  
   See Diamylbiphenyl  
 Pentiformic acid  
   See Caproic acid  
 2,5,8,11,14-Pentoxapentadecane  
   See Tetraethylene glycol dimethyl ether  
 Pentylamine  
   See Amylamine  
 $\gamma$ -Pentylene glycol  
   See 1,4-Pentanediol  
 1,5-Pentylene iodide  
   See 1,5-Diiodopentane  
 Pentylformic acid  
   See Caproic acid  
 Pentyl o-hydroxybenzoate  
   See Amyl salicylate  
 Pentyl methypropanoate  
   See Amyl butyrate  
 Pentyl nitrite  
   See Amyl nitrite  
 Pentyloxypentane  
   See Amyl ether  
 Pentyl sulfate  
   See Amyl sulfate  
 Perchlorethylene  
   See Tetrachloroethylene  
 Perchloromethane  
   See Carbon tetrachloride  
 Perchloromethyl formate  
   See Diphosgene  
 Perchloromethyl mercaptan  
   See Trichloromethanethiol  
 Petrol  
   See Gasoline  
 Petroleum naphtha  
   See Petroleum ether  
 Phene  
   See Benzene  
 Phenmethylol  
   See Benzyl alcohol  
 Phenoxy  $\beta$ -chloroethyl ether  
   See 1-(2-Chloroethoxy)-2-phenoxyethane  
 2-Phenoxyethanol  
   See Phenyl "Cellosolve"  
 2-Phenoxypropane  
   See Isopropyl phenyl ether  
 Phenylacetaldehyde  
   See  $\alpha$ -Tolualdehyde  
 Phenylacetic aldehyde  
   See  $\alpha$ -Tolualdehyde  
 Phenacylacetone  
   See 1-Phenyl-1,4-pentanedione  
 Phenylacetone nitrile  
   See  $\alpha$ -Tolunitrile  
 Phenylacetyl chloride  
   See  $\alpha$ -Toluy chloride  
 Phenylacetylene  
   See Ethynylbenzene  
 $\beta$ -Phenyl acrolein  
   See Cinnamaldehyde  
 Phenylamine  
   See Aniline

- Phenylamine acetate  
   See Aniline acetate  
 Phenyl azide  
   See Triazobenzene  
 Phenyl bromide  
   See Bromobenzene  
 Phenylbutane  
   See Butylbenzene  
 Phenyl carbinol  
   See Benzyl alcohol  
 Phenylcarbonimide  
   See Phenyl isocyanate  
 Phenyl chloride  
   See Chlorobenzene  
 Phenylchloroform  
   See Trichlorotoluene  
 Phenyl cyanide  
   See Benzonitrile  
 Phenyl dichlorophosphine  
   See Phosphenyl chloride  
 N-Phenyldiethylamine  
   See Diethylaniline  
 Phenyl diglycol carbonate  
   See Diethylene glycol bis  
   (phenyl carbonate)  
 Phenylethane  
   See Ethylbenzene  
 1-Phenylethanol  
   See  $\alpha$ -Methylbenzyl alcohol  
 2-Phenylethanol  
   See Phenethyl alcohol  
 $\beta$ -Phenylethyl compounds  
   See Phenethyl compounds  
 $\alpha$ -Phenylethyl alcohol  
   See  $\alpha$ -Methylbenzyl alcohol  
 $\alpha$ -Phenyl ethylamine  
   See  $\alpha$ -Ethylbenzylamine  
 Phenylethyl bromide  
   See Bromoethylbenzene  
 Phenylethyl chloride  
   See Chloroethylbenzene  
 Phenylethylene  
   See Styrene  
 Phenylethylene oxide  
   See (1,2-Epoxyethyl)-  
   benzene  
 Phenyl fluoride  
   See Fluorobenzene  
 Phenylfluoroform  
   See  $\alpha$ -Trifluorotoluene  
 Phenylhydride  
   See Benzene  
 Phenyl iodide  
   See Iodobenzene  
 dl-2-Phenylisopropylamine  
   See Benzedrine  
 Phenyl mercaptan  
   See Benzenethiol  
 Phenylmethane  
   See Toluene  
 Phenylmethoxyamine  
   See Benzyloxyamine  
 Phenyl methyl alcohol  
   See Benzyl alcohol  
 Phenyl methyl ketone  
   See Acetophenone  
 Phenylnitromethane  
   See  $\omega$ -Nitrotoluene  
 Phenylpentane  
   See Amylbenzene  
 Phenyl phosphite  
   See Triphenyl phosphite  
 3-Phenylpropanal  
   See Hydrocinnamaldehyde  
 1-Phenylpropane  
   See Propylbenzene  
 2-Phenylpropane  
   See Cumene  
 1-Phenyl-1-propanol  
   See  $\alpha$ -Ethylbenzyl alcohol  
 3-Phenylpropenal  
   See Cinnamaldehyde  
 1-Phenyl-1-propanone  
   See Propiophenone  
 1-Phenylpropene  
   See Propenylbenzene  
 $\beta$ - or 2-Phenylpropene  
   See  $\alpha$ -Methylstyrene  
 $\alpha$ -Phenylpropionic acid  
   See Hydratropic acid  
 $\beta$ -Phenylpropionitrile  
   See Hydrocinnamitrile  
 $\gamma$ -Phenylpropyl alcohol  
   See 3-Phenyl-1-propanol  
 sec-Phenyl propyl alcohol  
   See  $\alpha$ -Ethylbenzyl alcohol  
 $\alpha$ -Phenylpropyl bromide  
   See  $\alpha$ -Bromopropylbenzene  
 $\alpha,\alpha$ -Phenylpropylene  
   See Propenylbenzene  
 $\gamma$ -Phenylpropylene  
   See Allylbenzene  
 Phenyl propyl ketone  
   See Butyrophenone  
 Phenyl selenium  
   See Diphenylselenium  
 Phenylthiobenzene  
   See Phenyl sulfide  
 Phenyl thiocarbimide  
   See Phenyl isothiocyanate  
 Phenyl thiocarbonimide  
   See Phenyl isothiocyanate  
 Phenyltoluene  
   See Methylbiphenyl  
 Phenyl tolyl ketone  
   See Methylbenzophenone  
 Phenyltolylmethane  
   See Benzyltoluene  
 Phosphen-1  
   See Diphenyl butyl phenyl  
   phosphate  
 Phosphen-4  
   See Dichloropentanes  
 Phosphen-4  
   See o,o'-Dichlorophenyl  
   phenyl phosphate  
 Phosphen-6  
   See Phenyl-di-o-xenyl  
   phosphate  
 Phosphinoethane  
   See Ethylphosphine  
 Pimeln ketone  
   See Cyclohexanone  
 Pinacolin  
   See Pinacolone  
 $\gamma$ -Pipicolylcarbinol  
   See Piperidineethanol  
 Piperethylakine  
   See Piperidineethanol  
 Pivalic aldehyde  
   See Pivalaldehyde  
 Prehnitol  
   See Prehnitine  
 Propanal  
   See Propionaldehyde  
 Propanal oxime  
   See Propionaldehyde oxime  
 Propanenitrile  
   See Propionitrile  
 Propanoic acid  
   See Propionic acid  
 Propanoic anhydride  
   See Propionic anhydride  
 1-Propanol  
   See Propyl alcohol  
 2-Propanol  
   See Isopropyl alcohol  
 2-Propanol nitrate  
   See Isopropyl nitrate  
 2-Propanol nitrite  
   See Isopropyl nitrite  
 Propanone  
   See Acetone  
 Propanoyl compounds  
   See Propionyl compounds  
 Propargyl acetate  
   See 2-Propyn-1-ol acetate  
 Propargyl alcohol  
   See 2-Propyn-1-ol  
 Propargylaldehyde  
   See Propiolaldehyde  
 Propargyl bromide  
   See 3-Bromopropyne

Propargyl chloride  
   See 3-Chloropropyne  
 Propargylic acid  
   See Propiolic acid  
 Propargyl iodide  
   See 3-Iodopropyne  
 2-Propenal  
   See Acrolein  
 Propene acid  
   See Acrylic acid  
 Propenenitrile  
   See Acrylonitrile  
 Propenoic acid  
   See Acrylic acid  
 2-Propen-1-ol  
   See Allyl alcohol  
 Propene oxide  
   See Propylene oxide  
 2-Propenoxybenzene  
   See Allyl phenyl ether  
 3-(2-Propenoxy)-propene  
   See Allyl ether  
 Propenyl alcohol  
   See Glycerol  
 N-(-2-Propenyl)aniline  
   See N-Allylaniline  
 p-Propenylanisole  
   See Anethole  
 Propenyl bromide  
   See 1-Bromopropene  
 2-Propenyl butanoate  
   See Allyl butyrate  
 Propenyl carbinol  
   See 2-Buten-1-ol  
 2-Propenyl compounds  
   See Allyl compounds  
 Propenyl chloride  
   See 1-Chloropropene  
 Propenyl cyanide  
   See Crotononitrile  
 2-Propenyl ethanoate  
   See Allyl acetate  
 2-Propenyl ethanone  
   See Allyl acetate  
 $\alpha$ -Propenyl dichlorhydrin  
   See 1,3-Dichloro-2-propanol  
 4-Propenylguaiaicol  
   See Isoeugenol  
 3-(2-Propenylthio)-propene  
   See Allyl sulfide  
 Propiolic alcohol  
   See 2-Propyn-1-ol  
 Propionaldol  
   See  $\beta$ -Hydroxy- $\alpha$ -methyl-  
   valeraldehyde  
 Propionaldoxime  
   See Propionaldehyde oxime

Propione  
   See 3-Pentanone  
 Propionic aldehyde  
   See Propionaldehyde  
 o-Propionylphenol  
   See o-Hydroxypropiofenone  
 Propoxybenzene  
   See Phenyl propyl ether  
 1-Propoxypropane  
   See Propyl ether  
 2-Propoxypropane  
   See Isopropyl propyl ether  
 n-Propylacetylene  
   See 1-Pentyne  
 sec-Propyl alcohol  
   See Isopropyl alcohol  
 Propyl aldehyde  
   See Propionaldehyde  
 Propyl bromide  
   See 1-Bromopropene  
 Propyl chloride  
   See 1-Chloropropene  
 Propyl cyanide  
   See Butyronitrile  
 Propyl  $\alpha, \alpha'$ -dibromo-  
   succinate  
   See Dipropyl  $\alpha, \alpha'$ -dibromo-  
   succinate  
 Propylene aldehyde  
   See Crotonaldehyde  
 Propylene bromide  
   See 1,2-Dibromopropene  
 prim-Propylene bromohydrin  
   See 2-Bromo-1-propanol  
 Propylene chloride  
   See 1,2-Dichloropropene  
 prim-Propylene chlorohydrin  
   See 2-Chloro-1-propanol  
 sec-Propylene chlorohydrin  
   See 1-Chloro-2-propanol  
 dl-Propylenediamine  
   See dl-1,2-Propanediamine  
 Propylene dibromide  
   See 1,2-Dibromopropene  
 Propylene dichloride  
   See 1,2-Dichloropropene  
 Propylene diiodide  
   See 1,2-Diiodopropene  
 Propylene glycol  
   See 1,2-Propanediol  
 Propylene iodide  
   See 1,2-Diiodopropene  
 1,3-Propylene oxide  
   See Oxetane  
 Propylethylene  
   See 1-Pentene  
 Propylformic acid  
   See Butyric acid

Propylic aldehyde  
   See Propionaldehyde  
 Propylidene chloride  
   See 1,1-Dibromopropene  
 Propylidene chloride  
   See 1,1-Dichloropropene  
 Propylidene dibromide  
   See 1,1-Dibromopropene  
 Propylidene dichloride  
   See 1,1-Dichloropropene  
 Propyl iodide  
   See 1-Iodopropene  
 n-Propyl mercaptan  
   See 1-Propanethiol  
 Propylmethanol  
   See Butyl alcohol  
 Propyl orthoformate  
   See Tripropyl orthoformate  
 Propylphenyl carbinol  
   See  $\alpha$ -Propylbenzyl alcohol  
 Propyl phenyl ketone  
   See Butyrophenone  
 Propylphenyl methanol  
   See  $\alpha$ -Propylbenzyl alcohol  
 Propyl phthalate  
   See Dipropyl phthalate  
 1-(Propylsulfinyl) propane  
   See Propyl sulfoxide  
 1-Propylsulfonylpropane  
   See Propyl sulfone  
 1-Propylthiopropene  
   See Propyl sulfide  
 Propynal  
   See Propiolaldehyde  
 Propynoic acid  
   See Propiolic acid  
 Pseudobutyl alcohol  
   See tert-Butyl alcohol  
 Pseudobutylene glycol  
   See 2,3-Butanediol  
 Pseudopropyl alcohol  
   See Isopropyl alcohol  
 Pyromucic aldehyde  
   See 2-Furaldehyde  
 Pyromucyl chloride  
   See Furoyl chloride  
 Pyroacetic ether  
   See Acetone  
 Pyroacetic spirit  
   See Acetone  
 Pyroligneous spirit  
   See Methanol  
 Pyroxylic spirit  
   See Methanol  
 Quinanisole  
   See p-Methoxyquinoline

ylidene  
 See 1-Hendecyne  
 sorcinol diethyl ether  
 See *m*-Diethoxybenzene  
 sorcinol dimethyl ether  
 See 1,3-Dimethoxybenzene  
 sorcinol methyl ether  
 See *m*-Methoxyphenol  
 odinol  
 See *d*-Citronellol  
 Rhodinal  
 See *d*-Citronellal  
 ethyl  
 See Ethyl salicylate  
 ilyclic aldehyde  
 See Salicylaldehyde  
 limenthol  
 See Menthyl salicylate  
 lmester  
 See Methoxyethyl methyl  
 alicylate  
 mol  
 See Menthyl salicylate  
 ntyl  
 See Santylal salicylate  
 lenium diphenyl  
 See Diphenylselenium  
 lenium ethyl  
 See Ethyl selenide  
 lenium methyl  
 See Methyl selenide  
 lenophenol  
 See Benzeneselenol  
 extol" lactate  
 See Methylcyclohexyl  
 lactate  
 extone" B  
 See Methylcyclohexanone  
 ikimole  
 See Safrole  
 icon ester  
 See Ethyl orthosilicate  
 icon methyl  
 See Tetramethylsilicane  
 iconphenyl trichloride  
 See Trichlorophenyl-  
 silicane  
 icon tetraethyl  
 See Tetraethylsilicane  
 icon tetramethyl  
 See Tetramethylsilicane  
 lvan  
 See 2-Methylfuran  
 -Sobrerone  
 See *dl*-Pinol  
 irts of wine  
 See Ethyl alcohol

Styrene oxide  
 See (1,2-Epoxyethyl)-benzene  
 Styrol  
 See Styrene  
 Styrolene  
 See Styrene  
 Suberane  
 See Cycloheptane  
 Suberene  
 See Cycloheptene  
 Suberone  
 See Cycloheptanone  
 Suberylene  
 See Cycloheptene  
 Succinic dialdehyde  
 See Succinaldehyde  
 Sulfocarboic acid  
 See Phenolsulfonic acid  
 Sulfocyanic acid  
 See Thiocyanic acid  
 Sulfuric ether  
 See Ethyl ether  
 Sulvinite  
 See Ethyl chlorosulfonate  
 Superpalite  
 See Diphosgene  
 Sylvan  
 See 2-Methylfuran  
 Tanacetone  
 See  $\beta$ -Thujone  
 Tellurium ethyl  
 See Ethyl telluride  
 Tellurium methyl  
 See Methyl telluride  
 Terebenthina  
 See Turpentine  
 Terpane  
 See *p*-Menthane  
 $\Delta$  -1:8-Terpodiene  
 See Dipentene  
 sym-Tetrachloroacetone  
 See 1,1,3,3-Tetrachloro-  
 propanone  
 Tetrachlorethene  
 See Tetrachloroethylene  
 Tetrachloromethane  
 See Carbon tetrachloride  
 Tetradecanenitrile  
 See Myristonitrile  
 Tetradecanol  
 See 7-Ethyl-2-methyl-4-  
 hendecanol  
 Tetradecanoyl chloride  
 See Myristoyl chloride  
 $\alpha$ -Tetradecylene  
 See 1-Tetradecene

Tetradecyl mercaptan  
 See 1-Tetradecanethiol  
 Tetraethoxyethane  
 See Ethyl orthocarbonate  
 Tetraethyl germanium  
 See Germanium tetraethyl  
 Tetraethyl orthocarbonate  
 See Ethyl orthocarbonate  
 Tetraethyl orthosilicate  
 See Ethyl orthosilicate  
 Tetraethyl stannate  
 See Tetraethyltin  
 Tetraglycol dichloride  
 See Bis 2-(2-chloroethoxy)  
 ethyl ether  
 Tetrahydro-*p*-dioxin  
 See *p*-Dioxane  
 Tetrahydrofuryl carbinol  
 See Tetrahydrofurfuryl  
 alcohol  
 Tetrahydrogeraniol  
 See 3,7-Dimethyl-1-octanol  
 1,2,3,4-Tetrahydro-*o*-1-  
 methylquinoline  
 See Kairolin  
 1,2,3,4-Tetrahydronaph-  
 thalene  
 See Tetralin  
 Tetrahydro-1,4-oxazine  
 See Morpholine  
 Tetrahydropyrrole  
 See Pyrrolidine  
 1,2,3,6-Tetrahydrotoluene  
 See 4-Methylcyclohexene  
 Tetraisoamylstannane  
 See Tetraisoamyltin  
 2,3,4,6-Tetramethylamino-  
 benzene  
 See 2,3,4,6-Tetramethyl-  
 aniline  
 1,2,3,4-Tetramethylbenzene  
 See Prehnitine  
 1,2,3,5-Tetramethylbenzene  
 See Isodurene  
 $\alpha$ -Thenyl alcohol  
 See Thiophenemethanol  
 2- or  $\alpha$ -Thienylcarbinol  
 See Thiophenemethanol  
 2-Thienylformaldehyde  
 See 2-Thiophenecarboxal-  
 dehyde  
 Thioacetic acid  
 See Thiolacetic acid  
 Thioallyl ether  
 See Allyl sulfide  
 Thiobenzoic acid  
 See Thiolbenzoic acid

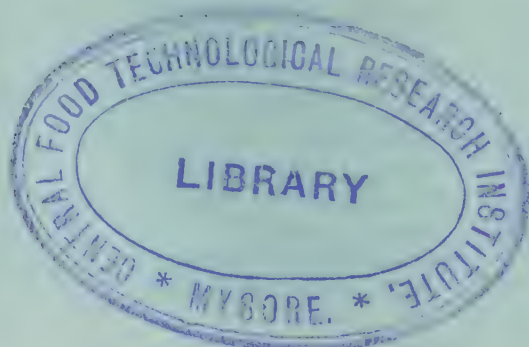
Thiocarbanil  
   See Phenyl isothiocyanate  
 Thiocarbonyl chloride  
   See Thiophosgene  
 Thiocresol  
   See *o*-Toluenethiol  
 Thiocresol methyl ether  
   See Methyl *p*-tolyl sulfide  
 Tetramethylene dichloride  
   See 1,4-Dichlorobutane  
 Tetramethylene dichloride  
   See 2,3-Dichlorobutane  
 Tetramethylene dicyanide  
   See Adiponitrile  
 Tetramethylene diiodide  
   See 1,4-Diiodobutane  
 Tetramethylene glycol  
   See 2,3-Butanediol  
 Tetramethylene oxide  
   See Tetrahydrofuran  
 Tetramethylenimine  
   See Pyrrolidine  
 Tetramethylplumbane  
   See Tetramethyllead  
 Tetramethylpyridine  
   See  $\beta$ -Parvoline  
 Tetramethylsilicon  
   See Tetramethylsilicane  
 Tetramethylstannane  
   See Tetramethyltin  
 Tetrapropylstannane  
   See Tetrapropyltin  
 Tetra-*o*-tolylstannane  
   See Tetra-*o*-tolyltin  
 Thiodiethylene glycol  
   See 2,2'-Thiodiethanol  
 $\beta$ -Thiodiglycol  
   See 2,2'-Thiodiethanol  
 Thioethylene glycol  
   See 2-Mercaptoethanol  
 Thiofuran  
   See Thiophene  
 Thioglycolic acid  
   See Mercaptoacetic acid  
 Thiohydracrylic acid  
   See  $\beta$ -Mercaptopropionic acid  
 Thiolactic acid  
   See  $\beta$ -Mercaptopropionic acid  
 Thio (b) monazole  
   See Thiazole  
 Thiomonoglycol  
   See 2-Mercaptoethanol  
 Thio-1-naphthol  
   See 1-Naphthalenethiol

2-Thiophenealdehyde  
   See 2-Thiophenecarboxaldehyde  
 2-Thiophenecarbinol  
   See Thiophenemethanol  
 2-Thiophenecarbonyl  
   See 2-Thiophenecarboxaldehyde  
 Thiophenetole  
   See Ethyl phenyl sulfide  
 Thiophenol  
   See Benzenethiol  
 Thiotoluene  
   See Methylthiophene  
 Thioxene  
   See Dimethylthiophene  
 1,3,4-Thymylamine  
   See 3-Aminocymene  
 Tin diethyl  
   See Diethyltin  
 Tin tetraethyl  
   See Tetraethyltin  
 Tin tetramethyl  
   See Tetramethyltin  
 Tin triethyl  
   See Triethyltin  
 $p$ -Tolubenzyl acetate  
   See  $p$ -Xylol acetate  
 $m$ -Tolubenzyl alcohol  
   See  $m$ -Tolylcarbinol  
 Tolubenzylamine  
   See Xylolamine  
 3,5-Toluenediamine  
   See 5- $m$ -Tolylenediamine  
 Toluenehexahydride  
   See Methylcyclohexane  
 Toluene sulfochloride  
   See *o*-Toluenesulfonyl chloride  
 Toluene tetrahydride  
   See Methylcyclohexene  
 Toluene trichloride  
   See *d, d, d*-Trichlorotoluene  
 Toluol  
   See Toluene  
 Toluquinoline  
   See Methylquinoline  
 Tolylaldehyde  
   See Tolualdehyde  
 3,5-Tolylenediamine  
   See 5- $m$ -Tolylenediamine  
 Tolly bromide  
   See Bromotoluene  
 Tollycarbonimide  
   See Tolly isocyanate  
 Tolly chloride  
   See Chlorotoluene

Tolly cyanide  
   See Tolunitrile  
 Tolly iodide  
   See Iodotoluene  
 Tolly mercaptan  
   See Toluenethiol  
 "Tri"  
   See 1,1,2-Trichloroethylene  
 2,4,6-Triaminotoluene  
   See 2,4,6-Toluenetriamine  
 Triamyl borate  
   See Amyl borate  
 Tribromoacetaldehyde  
   See Bromal  
 Tribromoaldehyde  
   See Bromal  
 2,2,2-Tribromoethanal  
   See Bromal  
 Tribromohydrin  
   See 1,2,3-Tribromopropane  
 Tribromomethane  
   See Bromoform  
 Tribromonitromethane  
   See Bromopicrin  
 Tributoxy ethyl phosphate  
   See Tributyl "Cellosolve" phosphate  
 Tributyl orthoformate  
   See Butyl arthoformate  
 Trichloroacetal  
   See 1,1,1-Trichloro-2,2-diethoxyethane  
 Trichloroacetaldehyde  
   See Chloral  
 Trichlorobutaldehyde  
   See 2,2,3-Trichlorobutyraldehyde  
 2,2,3-Trichlorobutanol  
   See 2,2,3-Trichlorobutyraldehyde  
 Trichloroethanal  
   See Chloral  
 Trichloroethyl alcohol  
   See 2,2,2-Trichloroethanol  
 Trichlorohydrin  
   See 1,2,3-Trichloropropane  
 Trichloromethane  
   See Chloroform  
 Trichloromethyl chloroformate  
   See Diphosgene  
 Trichloronitromethane  
   See Chloropicrin  
 Tricresyl phosphate  
   See Tritolyl phosphate  
 Tricresyl Phosphite  
   See See Tritolyl Phosphite

- Tridecylene  
   See Tridecene  
 Triethoxy borate  
   See Ethyl borate  
 1,1,1-Triethoxyethane  
   See Ethyl orthoacetate  
 Triethoxymethane  
   See Ethyl orthoformate  
 Triethyl borate  
   See Ethyl borate  
 Triethylcarbinol  
   See 3-Ethyl-3-pentanol  
 Triethylene glycol methyl ether acetate  
   See Methoxytriglycol acetate  
 Triethylmethane  
   See 3-Ethylpentane  
 Triethylmethylmethane  
   See 3-Ethyl-3-methylpentane  
 Triethyl orthoacetate  
   See Ethyl orthoacetate  
 Triethyl orthoformate  
   See Ethyl orthoformate  
 Triethyl silicol ethyl ether  
   See Ethyl triethylsilicyl oxide  
 Triethyl silicon hydride  
   See Triethylsilicane  
 Triethyl silicon oxide  
   See Hexaethylsilicyl oxide  
 Triethylstibine  
   See Triethylantimony  
 Triglycol  
   See Triethylene glycol  
 Tri-2-hydroxyethylamine  
   See Triethanolamine  
 Triisoamyl borate  
   See Isoamyl borate  
 Triisobutyl borate  
   See Isobutyl borate  
 3,4,5-Trimethoxyphenethylamine  
   See Mescaline  
 Trimethylacetaldehyde  
   See Pivalaldehyde  
 Trimethylacetone  
   See *a, a'*-Dimethylpropionitrile  
 Trimethylaminomethene  
   See *tert*-Butylamine  
 2,4,6-Trimethylaniline  
   See Mesidine  
 Trimethylarsine  
   See Trimethylarsenic  
 Trimethylbenzene  
   See Cumene  
 1,2,3-Trimethylbenzene  
   See Hemimellitene  
 sym- or 1,3,5-Trimethylbenzene  
   See Mesitylene  
 1,2,4-Trimethylbenzene  
   See Pseudocumene  
 vic-Trimethylbenzene  
   See Hemimellitene  
 Trimethylboron  
   See Trimethyl borate  
 Trimethylcarbonylamine  
   See *tert*-Butylamine  
 Trimethylchloromethane  
   See 2-Chloro-2-methylpropane  
 1,1,3-Trimethyl-1-cyclohexene-3-one-5  
   See Isophorone  
 3,5,5-Trimethylcyclohexene-2-one-1  
   See Isophorone  
 3,5,5-Trimethyl-2-cyclohexen-1-one  
   See Isophorone  
 Trimethylene bromide  
   See 1,3-Dibromopropane  
 Trimethylene bromochloride  
   See 1-Bromo-3-chloropropane  
 Trimethylene bromohydrin  
   See 3-Bromo-1-propanol  
 Trimethylene chloride  
   See 1,3-Dichloropropane  
 Trimethylene chlorobromide  
   See 1-Bromo-3-chloropropane  
 Trimethylene chlorohydrin  
   See 3-Chloro-1-propanol  
 Trimethylene cyanide  
   See 1,5-Pentanedinitrile  
 Trimethylenediamine  
   See 1,3-Propanediamine  
 Trimethylene dibromide  
   See 1,3-Dibromopropane  
 Trimethylene dichloride  
   See 1,3-Dichloropropane  
 Trimethylene dicyanide  
   See 1,5-Pentanedinitrile  
 Trimethylene diiodide  
   See 1,3-Diiodopropane  
 Trimethylene dimercaptan  
   See 1,3-Propanedithiol  
 Trimethylene formal  
   See *m*-Dioxane  
 Trimethylene glycol  
   See 1,2-Propanediol  
 Trimethylene glycol methylene ether  
   See *m*-Dioxane  
 Trimethylene iodohydrin  
   See 3-Iodo-1-propanol  
 Trimethylene methylene dioxide  
   See *m*-Dioxane  
 Trimethylene oxide  
   See Oxetane  
 Trimethylethylene  
   See 2-Methyl-2-butene  
 Trimethylethylene glycol  
   See 2-Methyl-2,3-butanediol  
 Trimethyliodomethane  
   See 2-Iodo-2-methylpropane  
 Trimethyl methanol  
   See *tert*-Butyl alcohol  
 d-1,2,3-Trimethyl-2-norcamphanone  
   See d-Fenchone  
 2,3,6-Trimethylnorpinane  
   See d-Pinane  
 Trimethylphenylmethane  
   See *tert*-Butylbenzene  
 Trimethyl phosphate  
   See Methyl phosphate  
 Trimethylpropylmethane  
   See 2,2-Dimethylpentane  
 2,4,6-Trimethylpyridine  
   See  $\gamma$ -Collidine  
 Trimethylstibine  
   See Trimethylantimony  
*a, a'*-Trimethyltrimethylene glycol  
   See 2-Methyl-2,4-pentanediol  
 2,4,6-Trimethyl-1,3,5-trioxane  
   See Paraldehyde  
 Trinitroglycerol  
   See Nitroglycerin  
 Trinitromethane  
   See Nitroform  
 Tripropoxyboron  
   See Propyl borate  
 Tripropyl borate  
   See Propyl borate  
 Tripropyl carbinol  
   See 4-Propyl-4-heptanol  
 Tritolyl phosphate  
   See Tolyl phosphate  
 Undecanal  
   See Hendecanal  
 Undecane  
   See Hendecane

- Undecanol  
   See 5-Ethyl-2-nonanol  
 1-Undecanol  
   See Hendecyl alcohol  
 2-Undecanol  
   See 2-Hendecanol  
 2-Undecanone  
   See 2-Hendecanone  
 3-Undecanone  
   See 3-Hendecanone  
 6-Undecanone  
   See 6-Hendecanone  
 1-Undecene  
   See 1-Hendecene  
 2-Undecene  
   See 2-Hendecene  
 Undecyl alcohol  
   See Hendecyl alcohol  
 n-sec-Undecyl alcohol  
   See Hendecanol  
 n-Undecylaldehyde  
   See Hendecanal  
 pri-n-Undecylamine  
   See Hendecylamine  
 n-Undecyl cyanide  
   See Lauronitrile  
 Undecylene  
   See Hendecene  
 Undecylene alcohol  
   See 10-Hendecen-1-ol  
 Undecylic aldehyde  
   See Hendecanal  
 Undecylic nitrile  
   See Hendecanenitrile  
 1-Undecyne  
   See 1-Hendecyne  
 Valamin  
   See tert-Amyl isovalerate  
 Valeraldehyde  
   See Isovaleraldehyde  
 Valerianic ether  
   See Ethyl valerate  
 act-Valeric acid  
   See d-Methylbutyric acid  
 Valeric aldehyde  
   See Isovaleraldehyde  
 n-Valeric aldehyde  
   See Valeraldehyde  
 Valerone  
   See 2,6-Dimethyl-4-heptanone  
 $\gamma$ -Oxo- (or  $\gamma$ -Keto-) valerophenone  
   See 1-Phenyl-1,4-pentanedione  
 Valerylene  
   See 2-Pentyne  
 Valido  
   See Menthyl isovalerate  
 Valyl  
   See N,N-Diethylvaleramide  
 Vinegar acid  
   See Acetic acid (glacial)  
 Vinegar naphtha  
   See Ethyl acetate  
 Vinic ether  
   See Ethyl ether  
 Vinylacetic acid  
   See 3-Butenoic acid  
 Vinylaceto- $\beta$ -lactone  
   See Diketone  
 Vinylaceto- $\beta$ -lactone  
   See Diketene  
 Vinylacetonitrile  
   See 3-Butenenitrile  
 Vinylacetylene  
   See 3-Buten-1-yne  
 Vinylanisole  
   See Methoxystyrene  
 Vinylbenzene  
   See Styrene  
 Vinyl bromide  
   See Bromoethylene  
 Vinyl cyanide  
   See Acrylonitrile  
 Vinylethyl alcohol  
   See 3-Buten-1-ol  
 Vinylethylene oxide  
   See 3,4-Epoxy-1-butene  
 Vinylformic acid  
   See Acrylic acid  
 Vinylidene chloride  
   See 1,1-Dichloroethylene  
 Vinyl iodide  
   See Iodoethylene  
 m-Vinylphenol  
   See m-Hydroxystyrene  
 Vinyl tribromide  
   See 1,1,2-Tribromoethane  
 Vinyl trichloride  
   See 1,1,2-Trichloroethane  
 White mineral oil  
   See Petrolatum (Liquid)  
 Wood naphtha  
   See Methanol  
 Wood alcohol  
   See Methanol  
 Wood spirits  
   See Methanol  
 Xanthogenic acid  
   See Xanthic acid  
 Xylol  
   See Xylene  
 m-Xylol  
   See m-Tolylcarbinol  
 Xylol bromide  
   See Bromoxylene  
 Xylol chloride  
   See Chloroxylene  
 Zinc diethyl  
   See Diethylzinc  
 Zinc diisopropyl  
   See Diisopropylzinc  
 Zinc dimethyl  
   See Dimethylzinc  
 Zinc di-n-propyl  
   See Dipropylzinc  
 Zinc ethide  
   See Diethylzinc





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